FENNER LAKE
LAKE CLASSIFICATION REPORT

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EXECUTIVE SUMMARY

Background Information about Fenner Lake

Fenner Lake is a 33.8-acre natural seepage lake located mainly in the Town of New Chester, Adams County, in the Central Sand Plains Area of Wisconsin. According to the WDNR depth map, it has a maximum depth of 30' and an average depth of 5'. A "seepage lake" is a natural lake with no natural stream inlet or outlet and fed by precipitation, runoff and groundwater. A small part of the lake, including the public boat ramp and small beach, are in Marquette County.

This lake has no natural stream inlet or outlet. The lake is fed by precipitation, runoff and groundwater. Fenner Lake is part of the Neenah Creek Watershed, a large watershed of 182 square miles which flows into the Fox River and eventually into Lake Michigan. There is a public boat ramp on the east side of the lake, owned by Marquette County. There is a Native American archeological site, mostly burial mounds, located around Fenner Lake that cannot be further disturbed without permission of the federal government and input from the local tribes.

Except for some pockets of muck and sandy loam, the soils in the surface watershed for Fenner Lake are loamy sand and sand, with slopes from very flat up to 25%. Sandy soils dominate the ground watershed, followed by loamy sand. These soils tend to be well- to excessively drained, no matter what the slope. Water, air and nutrients move through these soils at a rapid rate, so that little runoff occurs unless the soil becomes saturated. These soils have little water-holding capacity and low natural fertility. Water erosion, wind erosion & drought are all hazards with these soils, especially since they dry out so quickly. Onsite waste disposal in these soils is also a problem because of slope and seepage; mound systems are usually required.

Land Use in Fenner Lake Watersheds

Both the surface and ground watersheds of Fenner Lake are fairly small. The most common current land uses in the Fenner Lake Surface Watershed are non-irrigated agriculture and woodlands. In the ground watershed, woodlands dominate.

Fenner Lake has a total shoreline of 1.0 miles (5280 feet). About half of the immediate shore area is in residential use. Much of the area near the shore is steeply sloped. Buildings are generally located 70 or more feet back from the shore. 76.5% of Fenner Lake's shoreline is vegetated. Several areas of the shore, especially at the east end, have significant erosion currently occurring.

The 2004 inventory included classifying areas of the Fenner Lake shorelines as having "adequate" or "inadequate" buffers. An "adequate" buffer was defined as one having the first 35 feet landward covered by native vegetation. An "inadequate" buffer was anything that didn't meet the definition of "adequate buffer", including native vegetation strips less than 35 feet landward. Using these definitions, 71.47% (about 3916 feet) of Fenner Lake's shoreline had an "adequate buffer", leaving 25.83% (1364 feet) as "inadequate." Most of the "inadequate" buffer areas were found with l mowed lawns and/or insufficient native vegetation at the shoreline to cover 35 feet landward from the water line. Adequate buffers on Fenner Lake could be easily installed in the inadequate areas by either letting the first 35 feet landward from the water just grow without mowing it, except for a path to the water, or by planting native seedlings sufficient to fill in the first 35 feet.

Water Testing Results

Between 2004 and 2006, Adams County Land & Water Conservation Department gathered water chemistry and other water quality information on Fenner Lake. Overall, Fenner Lake was determined to be a mesotrophic lake with very good water quality and water clarity.

Measuring the phosphorus in a lake system provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth. The 2004-2006 summer average phosphorus concentration in Fenner Lake was 21 micrograms/liter. This is below the 25 micrograms/liter average recommended for natural lakes in Wisconsin to avoid algal blooms. This concentration suggests that Fenner Lake is likely to have few nuisance algal blooms. This places Fenner Lake in the "good" water quality section.

Water clarity is a critical factor for plants. If plants don't get more than 2% of the surface illumination, they won't survive. Water clarity is measured with a Secchi disk. Average summer Secchi disk clarity in Fenner Lake in 2004-2006 was 9.66 feet. This is very good water clarity. Records since 1990 show that the water clarity in Fenner Lake has consistently remained high.

Chlorophyll-a concentrations provide a measurement of the amount of algae in a lake's water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth, as well as result in unpleasing odor and appearance. The 2004-2006 summer (June-September) average chlorophyll-a concentration in Fenner Lake was 3.2 micrograms/liter, a low algal concentration.

Low dissolved oxygen levels during the summer in the bottom waters of a lake occurs naturally as oxygen in the bottom layer is consumed, but not replenished. As the summer progresses, the oxygen concentration of the bottom waters may decrease. In Fenner Lake, there were hypoxic (low oxygen) periods in the lower depths of the lake during the summers of 2004 and 2005. Besides being a potential danger to a lake's fish population, summer hypoxia can result in phosphorus being released into the upper water column and being available for algal blooms and increased aquatic plant growth. The data collected at Fenner Lake from 2004-2006 shows there is a potential for phosphorus loading from the lower depths (hypolimnion) during the summer months in Fenner Lake if the hypoxia/anoxia continues. Dissolved oxygen needs to be monitored during the late summer months in the lower depths on Fenner Lake to determine whether hypoxia/anoxia is a frequently-occurring condition that may need to be addressed by management practices.

Water testing results for Fenner Lake showed "hard" water (109.67 mg/l CaCO3). Hard water lakes tend to produce more fish and aquatic plants than soft water lakes because they are often located in watersheds with soils that load phosphorus into the lake water. Average alkalinity in Fenner Lake during the testing period was 104.8 ueq/l.

A lake with a neutral or slightly alkaline pH like Fenner Lake is a good lake for fish and plant survival. Natural rainfall in Wisconsin averages a pH of 5.6. This means that if the rain falls on a lake without sufficient alkalinity to buffer that acid water coming in by rainfall, the lake's fish cannot reproduce. That is not a problem at Fenner Lake.

Other water quality testing at Fenner Lake showed no particular areas of concern. The average calcium level in Fenner Lake's water during the testing period was 20.3 mg/l. The average Magnesium level was 12.98 mg/l. Both of these are low-level readings. Although the presence of a significant amount of chloride over a period of time may indicate that there are negative human impacts on the water quality present, chloride levels found in Fenner Lake during the testing period were all below 3 mg/l, at about the natural level of chloride in this area of Wisconsin. Nitrogen levels can also affect other aspects of water quality. The sum of water testing results for nitrate, nitrite and ammonium levels of over .3 mg/l in the spring can be used to project the likelihood of an algal bloom in the summer (assuming sufficient phosphorus is also present). Fenner Lake combination nitrogen levels from 2004 to 2006 did rise to 1.3 mg/l, well above the .3 mg/l predictive level for algal blooms. Given appropriate conditions, Fenner Lake might suffer nitrogen-related algal blooms.

Both sodium and potassium levels in Fenner Lake were very low: the average sodium level was 1.32 mg/l; the average potassium reading was .5 mg/l. To prevent the formation of hydrogen sulfate, levels of 10 mg/l are best. A health advisory kicks in at 30 mg/l. Fenner Lake sulfate levels average 3.24 mg/l during the testing period, far below either level. Turbidity reflects water clarity. The term refers to suspended solids in the water column—solids that may include clay, silt, sand, plankton, waste, sewage and other pollutants. Very turbid waters may not only smell and mask bacteria & other pollutants, but also tend to be aesthetically displeasing, thus curtailing recreational uses of the water. Turbidity levels for Fenner Lake's waters were all at very low levels.

Phosphorus

Like most lakes in Wisconsin, Fenner Lake is a phosphorus-limited lake: of the pollutants that end up in the lake, the one that most affects the overall quality of the lake water is phosphorus. The amount of phosphorus especially affects the frequency and density of aquatic vegetation and the frequency and density of various kinds of algae, as well as water clarity and other quality aspects.

The total phosphorus (TP) concentration in a lake is considered a good indicator of a lake's nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For a natural lake like Fenner Lake, a total phosphorus concentration below 20 micrograms/liter tends to indicate few nuisance algal blooms are likely to occur. Fenner Lake's growing season (June-September) surface average total phosphorus level of 21 micrograms/liter is just above that level, so nuisance algal blooms may occur, but are probably localized.

Land use plays a major role in phosphorus loading. The land uses in the Fenner Lake surface watershed that contribute the most phosphorus are non-irrigated agriculture and irrigated agriculture. Some phosphorus deposition cannot be controlled by humans. However, some phosphorus (and other nutrient) input can be decreased or increased by changes in human land use patterns. Practices such as waterbody shoreland buffer restoration; infiltrating stormwater runoff from roof tops, driveways and other impervious surfaces; using no phosphorus lawn fertilizers; and reducing phosphorus input to and properly managing septic systems will minimize phosphorus inputs into the lake.

Reducing the amount of input from the surface and ground watersheds results in less nutrient loading into the lake itself. Under modeling predictions, reducing phosphorus inputs from human-based activities even 10% would improve Fenner Lake in-lake water quality by 1.6 to 3 micrograms of phosphorus/liter; a 25% reduction would save 6 to 9 micrograms/liter. Currently, both the spring turnover and summer phosphorus levels are below the threshold value of 20 micrograms/liter, but a phosphorus increase from human activities of only 25% would put the phosphorus levels in the lake over that threshold in the summer. The result would be more algal blooms and more aquatic plants. Decreases would reduce those problems. The modeling predictions make it clear that reducing current phosphorus human-impacted inputs to the lake are essential to improve, maintain and protect Fenner Lake's health for future generations.

Aquatic Plant Community

The Fenner Lake aquatic plant community is characterized by high quality and excellent species diversity. The plant community is in the top quartile of lakes in the state and region, the group of lakes closest to an undisturbed condition and with an average sensitivity to disturbance.

Myriophyllum sibiricum (Northern watermilfoil) was the most frequently occurring species in Fenner Lake in 2005. *Myriophylum sibiricum* was also the species with the highest mean density in Fenner Lake and exhibited an above average growth density where it was present. Seven other species also had above average growth density where they were found. *Myriophyllum sibiricum* was also the dominant aquatic plant species in Fenner Lake. *Ceratophyllum demersum* and *Nymphaea odorata* were sub-dominant.

Myriphyllum spicatum (Eurasian watermilfoil), an aggressive invasive species, was found in Fenner Lake during the later summer of 2005. Another invasive, *Potamogeton crispus* (Curly-Lead Pondweed) was seen during a field survey in May 2006. A rough field survey in 2007 showed these had spread, fanning either direction near the boat ramp. The Fenner Lake Association will need to develop a management plan to deal with these invasives.

Critical Habitat Areas

Wisconsin Rule 107.05(3)(i)(I) defines a "critical habitat areas" as: "areas of aquatic vegetation identified by the department as offering critical or unique fish & wildlife habitat or offering water quality or erosion control benefits to the body of water. Thus, these sites are essential to support the wildlife and fish communities. They also provide mechanisms for protecting water quality within the lake, often containing high-quality plant beds. Finally, critical habitat areas often can provide the peace, serenity and beauty that draw many people to lakes. Three areas on Fenner Lake—covering much of the lake's shores--were determined by a team of lake professionals to be appropriate for critical habitat designation.

Area FE1 extends along approximately 1500 feet of the northeast shoreline, up to the ordinary high water mark and, where there are wetlands, landward of the lake through the wetlands. 12.5% of the shore is wooded; 17.5% has shrubs; 47.5% is native herbaceous cover. The balance of the shore in this area includes a small area of cultivated lawn and pavement. Large woody cover is present for habitat. With human disturbance along this shoreline, the area has some natural scenic beauty, although a paved road runs near the area. Several types of aquatic plants were found in this critical habitat area: emergents (seven species); floating-leaf rooted plants (three species); and submergent plants (thirteen species). One exotic invasive plant, *Potamogeton crispus,* was seen in this area, Curly-Leaf Pondweed in 2006.

Area FE2 extends along approximately 2500 feet along the southwest shoreline. Sediment includes muck, peat, sand, silt and mixtures thereof. 22.5% of the shore is wooded; 7.5% has shrubs; and 61.25% is native herbaceous cover. The remaining shore in this area is cultivated lawn and hard structure. Large woody cover is present. With minimal human disturbance along this shore, the area is has natural scenic beauty. No threatened or endangered species were found in this area. Filamentous algae were not common in this area. Found at this site were six emergent aquatic plant species, three floating-leaf rooted plant species, and thirteen submergent aquatic species.

Area FE3 extends along approximately 450 feet of the southeast shoreline. Sediment includes gravel, peat, sand, and mixtures thereof. 32.5% of the shore is wooded; 12.5% has shrubs; 32.5% is native herbaceous cover—the remaining is bare sand. Large woody cover is common. Scenic beauty in part of the area is lessened due to the human development, especially the proximity of the sand boat ramp area. No threatened or endangered species were found in this area. Filamentous algae were not common in this area. Found at this site were six emergent aquatic plant species, three floating-leaf rooted plant species, and thirteen submergent aquatic species.

Fish/Wildlife/Endangered Resources

WDNR fish stocking records for Fenner Lake go back to 1957 with the stocking of some northern pike. Through the fifteen years after that, pike continued to be stocked, as well as bluegills and largemouth bass. An aerator was installed in 1976 to prevent winter kill of fish. Fish known in Fenner Lake include northern pike, largemouth bass, bluegill, pumpkinseed, yellow perch, crappie, bullhead, suckers and other panfish. No rusty crayfish were noted.

Seen during the critical habitat field survey were various types of waterfowl, songbirds, and turkey. Frogs and salamanders are known, using the lake shores for shelter/cover, nesting and feeding. Turtles and snakes also use this area for cover or shelter in this area, as well as nested and fed in this area. Upland wildlife feed and nest here as well.

Fenner Lake Watersheds shelter several natural communities designated by the WDNR as communities that are endangered: Calcareous fen; Emergent marsh; Northern sedge meadow; Oak barrens; Open bog; and Southern sedge meadow.

Conclusion

Fenner Lake is currently a fairly healthy lake with many positive aspects, as discussed in this report. The Fenner Lake Association should develop a lake management plan that addresses shoreland restoration in the eroding areas, integrated management of invasive species, reduction of human-impacts on phosphorus loading, well-managed land use and monitoring for water quality and invasive species. Care should be taken to maintain the overall very good quality of the lake and its surroundings.

It is hoped that the recommendations below will help in these aims.

RECOMMENDATIONS

Lake Management Plan

Fenner Lake does not currently have a lake management plan. Part of the delay has been due to the lack of information until the conclusion of the lake classification study. If requested by the Fenner Lake Association, Adams County Land & Water Conservation Department will assist them in developing a lake management plan.

This plan will need to include the following aspects concerning the management of the lake (and others): aquatic plant management; control/management of invasive species; wildlife and fishery management; watershed management; shoreland protection; critical habitat protection; water quality protection.

Watershed Recommendations

Although neither the surface nor ground watershed for Fenner Lake is particularly large, results of the modeling certainly suggests that input of nutrients, especially phosphorus, are a factor that needs to be explored for Fenner Lake.

Therefore, it is recommended that both the surface and ground watersheds be inventoried, documenting any of the following: runoff from any livestock operations that may be entering the surface water; soil erosion sites; agricultural producers not complying with nutrient management plans and/or irrigation water management plans.

If such sites are documented, steps for dealing with these issues can be incorporated into the lake management plan to be completed by the end of 2008.

Shoreland Recommendations

Based on the 2005 aquatic plant survey and the 2004 shoreland survey, the following recommendations are made concerning aquatic plants and aquatic invasive species:

All lake residents should practice best management on their lake properties, including keeping septic systems cleaned and in proper condition, eliminating the use of lawn fertilizers, cleaning up pet wastes and not composting near the water.

Aquatic Plant/Aquatic Invasive Species

1) Residents should become involved in the Citizen Lake Water Monitoring Program, Invasive Species Monitoring and Clean Boats, Clean Waters. This will allow not only noting changes in the Eurasian Watermilfoil and Curly-Leaf Pondweed patterns, but also help identify any new species. Noting the presence and density of these species early is the best way to take preventive action to keep them from becoming a bigger problem.

2) Lake residents should protect and increase natural shoreline in some areas of the lake around Fenner Lake. In general, disturbed shoreline sites support an aquatic plant community that is less able to resist invasions of exotic species and shows impacts from nutrient enrichment.

3) All lake users should protect the aquatic plant community in Fenner Lake by disturbing it as little as possible, by encouraging boats to stay out of plant beds, and by pulling invasive weeds identified there.

4) The Fenner Lake Association should maintain exotic species signs at the boat landings and contact WDNR if the signs are missing or damaged.

5) The Fenner Lake Association should monitor Eurasian Watermilfoil and Curly-Leaf Pondweed, as well as investigate options for managing these invasives. and hand-pulling. Residents should be encouraged to hand-pull scattered invasive plants.

6) A survey should be done to determine if Fenner Lake is an appropriate habitat for the native weevil that attacks Eurasian Watermilfoil.

Critical Habitat Recommendations

There are also several recommendations appropriate for the critical habitat areas.

(1) Maintain current habitat for fish and wildlife.
(2) Do not remove fallen trees along the shoreline nor logs in the water.
(3) No alteration of littoral zone unless to improve spawning habitat.
(4) Seasonal protection of spawning habitat.
(5) Maintain snag/cavity trees for nesting.
(6) Maintain or increase wildlife corridor.
(7) Maintain sedge meadow and deep marsh areas.
(8) Maintain no-wake zone.
(9) Protect emergent vegetation for habitat and shoreline protection.
(10) Removal of submergent vegetation for navigation purposes only.
(11) Seasonal control of Eurasian Watermilfoil and Curly-Leaf Pondweed by using control methods specific for exotics.
(12) Minimize aquatic plant and shore plant removal to maximum 30' wide access/viewing corridor. Leave as much vegetation as possible to protect water quality and habitat.
(13) Use forestry best management practices.
(14) No use of lawn products.
(15) No bank grading or grading of adjacent land.
(16) No pier construction or other activity except by permit using a case-by-case evaluation.
(17) No installation of pea gravel or sand blankets.
(18) No bank restoration unless the erosion index scores moderate or high.
(19) If the erosion index does score moderate or high, bank restoration only using biologs or similar bioengineering, with no use of riprap or retaining walls.
(20) Placement of swimming rafts or other recreational floating devices only by permit.
(21) Maintain buffer of shoreline vegetation.
(22) Maintain aquatic vegetation in undisturbed condition for wildlife habitat, fish use and water quality protection.
(23) Post landing with exotic species alert and educational signs to prevent introduction and/or spread of exotic species.
(24) Maintain lake as no-motor lake.

LAKE CLASSIFICATION REPORT FOR FENNER LAKE, ADAMS COUNTY

INTRODUCTION

In 2003, The Adams County Land & Water Conservation Department (Adams County LWCD) determined that a significant amount of natural resource data needed to be collected on the lakes with public access in order to provide it and the public with information necessary to manage the lakes in a manner that would preserve or improve water quality and keep it appropriate for public use. In some instances, there was significant historical data about a particular lake; in that instance, the study activities concentrated on combining and updating information. In other instances, there was no information on a lake, so study activities concentrating on gathering data about that lake. Further, it was discovered that information was scattered among various citizens, so often what information was actually available regarding a particular lake was unknown. To assist in updating some information and gathering baseline information, plus centralize the data collected, so the public may access it. The Adams County LWCD received a series of grants from the Wisconsin Department of Natural Resources (WDNR) from the Lake Classification Grant Program.

Objectives of the study were:

- collect physical data on the named lakes to assist in assessing the health of Adams County lake ecosystems and in classifying the water quality of the lakes.
- collect chemical and biological data on the named lakes to assist in assessing the health of Adams County lake ecosystems and in classifying the water quality of the lakes.
- develop a library of lake information that is centrally located and accessible to the public and to City, County, State and Federal agencies.
- make specific recommendations for actions and strategies for the protection, preservation and management of the lakes and their watersheds.
- create a baseline for future lake water quality monitoring.
- Provide technical information for the development of comprehensive lake management plans for each lake
- provide a basis for the water quality component of the Adams County Land and Water Resource Management Plan. Components of the plan will be incorporated into Adams County's "Smart Growth Plan".
- develop and implement educational programs and materials to inform and education lake area property owners and lake users in Adams County.

METHODS OF DATA COLLECTION

To collect the physical data, the following methods were used:

- delineation & mapping of ground & surface watersheds using topographic maps, ground truthing and computer modeling;
- identification of flow patterns for both the surface & ground watersheds using known flow maps and topographic maps;
- inventory & mapping of current land use with orthographic photos and collected county information;
- inventory & mapping of shoreline erosion and buffers using county parcel maps and visual observation;
- inventory & mapping for historical and cultural sites using information from the local historical society and the Wisconsin Historical Society;
- identification & mapping of critical habitat areas with WDNR and Adams County LWCD staff;
- identification & mapping of endangered or threatened natural resources (including natural communities, plant & animal species) using information from the Natural Heritage Inventory of Wisconsin;
- identification & mapping of wetland areas using WDNR and Natural Resource Conservation Service wetland maps;
- preparation of soil maps for each of the lake watersheds using soil survey data from the Natural Resource Conservation Service.

To collect water quality information, different methods were used:

- for three years, lakes were sampled during late winter, at spring and fall turnover, and several times during the summer for various parameters of water quality, including dissolved oxygen, relevant to fish survival and total phosphorus, related to aquatic plant and algae growth;
- random samples from wells in each lake watershed were taken in two years and tested for several factors;
- aquatic plant surveys were done on all 20 lakes and reports prepared, including identification of exotics, identifying existing aquatic plant community, evaluation of community measures, mapping of plant distribution, and recommendations;
- all lakes were evaluated for critical habitat areas, with reports and recommendations being made to the respective lakes and the WDNR;
- lake water quality modeling was done using data collected, as well as historical data where it was available.

WATER QUALITY COMPUTER MODELING

Wisconsin developed a computer modeling program called WiLMS (Wisconsin Lake Modeling Suite) to assist in determining the amount of phosphorus being loaded annually into a lake, as well as the probable source of that phosphorus. This suite has many models, including Lake Total Phosphorus Prediction, Lake Eutrophic Analysis Procedure, Expanded Trophic Response, Summary Trophic Response, Internal Load Estimator, Prediction & Uncertainty Analysis, and Water & Nutrient Outflow. The models that various types of data inputs: known water chemistry; surface area of lake; mean depth of lake; volume of lake; land use types & acreage. This information is then used in the various models to determine the hydrologic budget, estimated residence time, flushing rate, and other parameters.

Using the data collected over the course of the studies, various models were run under the WiLMS Suite. These water quality models are computer-based mathematical models that simulate lake water quality and watershed runoff conditions. They are meant to be a tool to assist in predicting changes in water quality when watershed management activities are simulated. For example, a model might estimate how much water quality improvement would occur if watershed sources of phosphorus inputs were reduced. However, it should be understood that these models predict only a relative response, not an exact response. Modeling results will be incorporated into topic discussions as appropriate.

DISSEMINATION OF PROJECT DELIVERABLES

The results of this study will be distributed various agencies, organizations and the public as previously described. Based on the classification information, the Adams County Land and Water Conservation Department will identify assistance requests and determine the appropriate future activities, based on the classification determinations. To provide the requested assistance, Adams County Land and Water Conservation Department will incorporate the lake management plans goals, priorities and action items into its Annual Plan of Operations. Goals, priorities and action items may include educational programs, formation of lake districts, further development of lake management plans and implementation of lake management plans.

ADAMS COUNTY INFORMATION

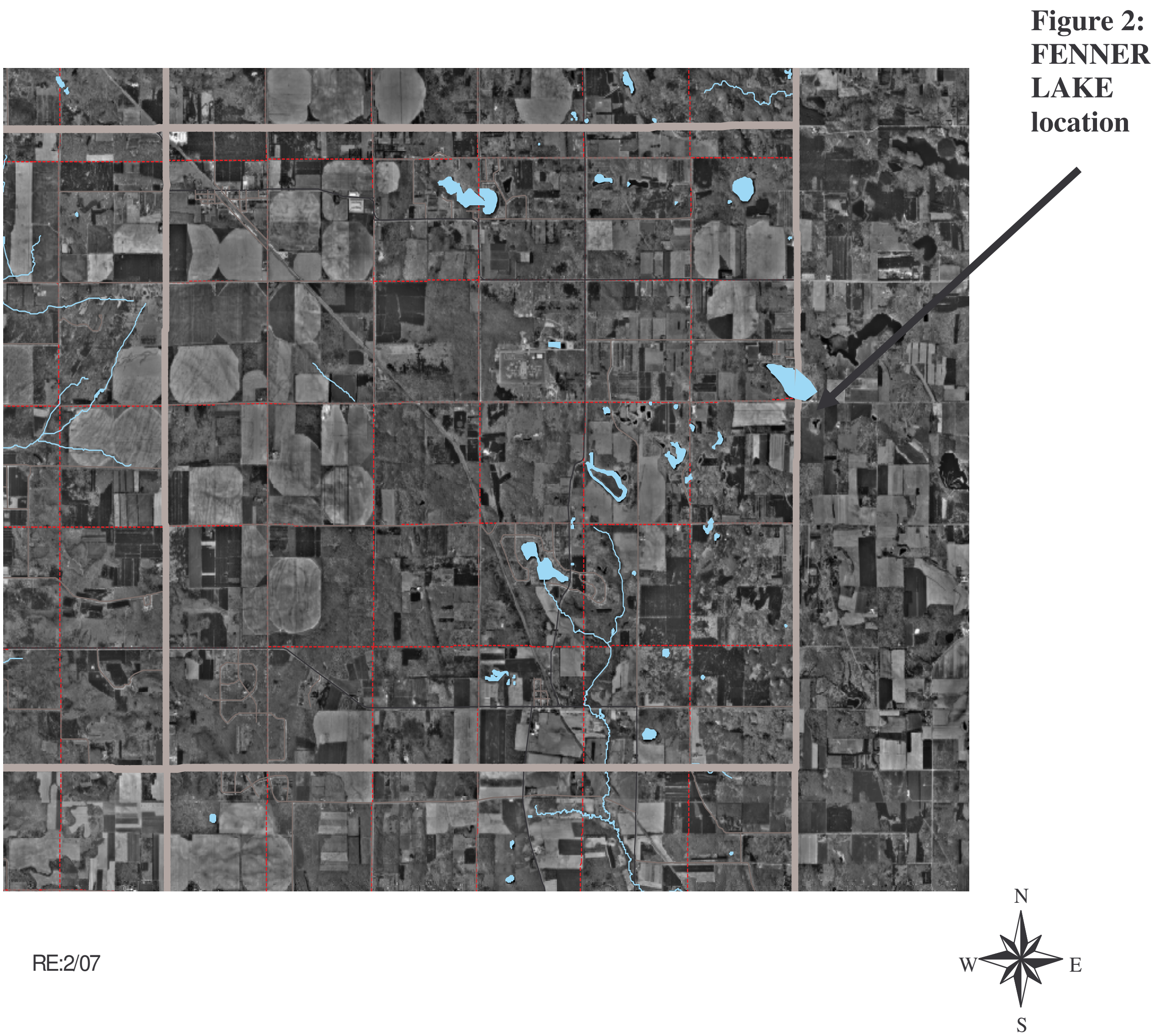
Adams County lies in south central Wisconsin, shaped roughly like the outline of Illinois. Adams County is a small rural county with a full-time population of about 20,000. Between 1980 and 2000, Adams County's population grew by more than 20%, with most of the population increase being located upon the lakes and streams. The population increase has resulted in a greater need for facilitation, technical assistance and education, including information on the lakes and streams.

Figure 1: Adams County Location in Wisconsin

FENNER LAKE BACKGROUND INFORMATION

Fenner Lake is a 33.8-acre natural seepage lake located mainly in the Town of New Chester, Adams County, in the Central Sand Plains Area of Wisconsin. According to the WDNR depth map, it has a maximum depth of 30' and an average depth of 5'. A "seepage lake" is a natural lake with no natural stream inlet or outlet and fed by precipitation, runoff and groundwater. A small part of the lake, including the public boat ramp and small beach, are in Marquette County.

Figure 2: FENNER LAKE location

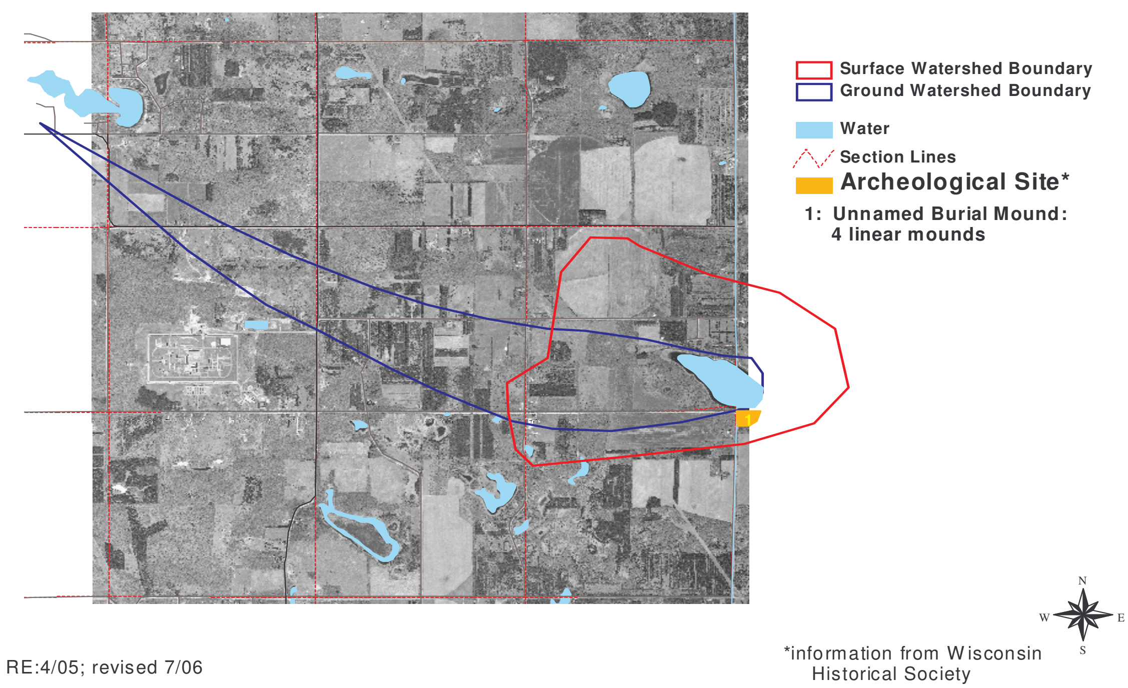


Fenner Lake is part of the Neenah Creek Watershed, a large watershed of 182 square miles which flows into the Fox River and eventually into Lake Michigan. The Central Sand Hills, which contain Fenner Lake, are an ecological landscape (a recessional moraine) on the eastern edge of what was Glacial Lake Wisconsin. The area is characterized by glacial moraines and glacial outwash, as well as the kettle holes that formed natural lakes—such as Fenner Lake. Elevations average between 900 to 1000 feet above sea level.

Archeological Sites

There are many Native American archeological sites in Adams County, with one located on the southeast side of Fenner Lake. Under the federal act on Native American burials, these sites cannot be further disturbed without permission of the federal government and input from the local tribes.

Figure 3: Fenner Lake Archeological Sites



Bedrock and Historical Vegetation

Bedrock around Fenner Lake is mostly sandstone, formed in the Cambrian Period of Geology (542 to 488 millions years ago). Bedrock is generally 50' to 100' down from the land surface. The topography of this area is a series of glacial moraines that were partly covered by glacial outwash to from glacial plains and hummocky moraines

Original upland vegetation of the area around Fenner Lake included oak-forest, oak savanna and tallgrass prairie. Fens were also common, including wet-mesic prairies, wet prairie, and rare coastal plain marshes. The small kettle lakes of this region tend to have fairly soft water.

Soils in the Fenner Lake Watersheds

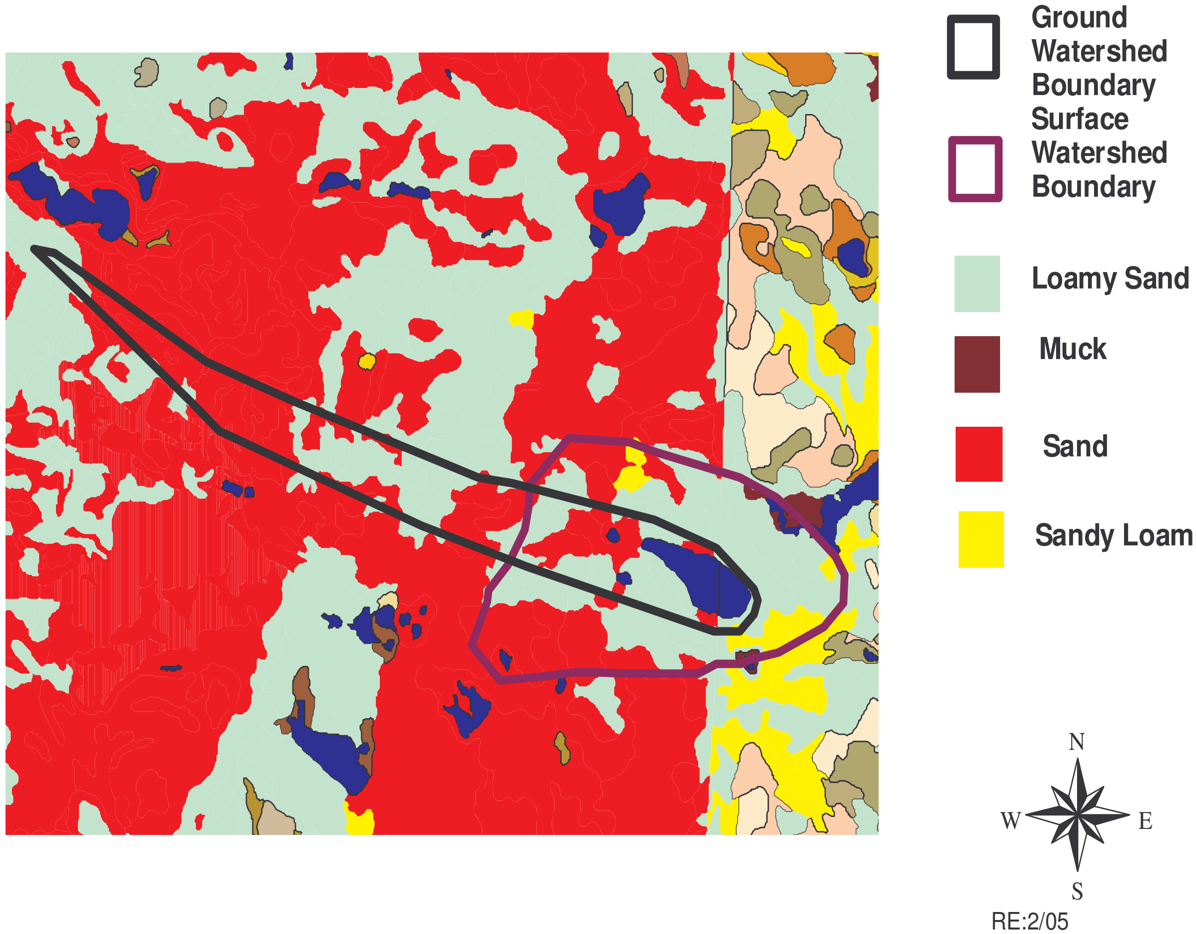
Except for some pockets of muck and sandy loam, the soils in the surface watershed for Fenner Lake are loamy sand and sand, with slopes from very flat up to 25%. Sandy soils dominate the ground watershed, followed by loamy sand.

Sandy soils tend to be excessively drained, no matter what the slope. Water, air and nutrients move through sandy soils at a rapid rate, so that little runoff occurs unless the soil becomes saturated. Although water erosion can be a problem, wind erosion may be more of a hazard with sandy soils, especially since they dry out so quickly. There are also draught hazards with sandy soils. Getting vegetation started in sandy soils is often difficult due to the low available water capacity, as well as low natural fertility and organic material. Onsite waste disposal in sandy soils is also a problem because of slope and seepage; mound systems are usually required.

Loamy sands tend to be well-drained, with water, air and nutrients moving through them at a rapid rate. Runoff, when it occurs, tends to be slow. Loamy sands have little water-holding capacity and low natural fertility, although they usually have more organic matter present than do sandy soils. Both wind and water erosion are potential hazards with loamy sands, as is drought. The same difficulties with waste disposal and vegetation establishment are present with loamy sands as with sandy soils.

The soil and soil slopes around lakes and streams are very important to water quality. They affect amount of infiltration of surface precipitation into the ground and the amount of contaminants that may reach the groundwater, as well as the amount of surface stormwater runoff. In addition, these two factors affect the amount and content of pollutants and particles (including soil) that may wash into a water body, affecting its water quality, its aquatic plant community and its fishery. Further, soil types and soil slopes help determine the appropriate private sewage system and other engineering practices for a particular site, since they affect absorption, filtration and infiltration of contamination from engineering practices.

Figure 4: Fenner Watersheds Soils



CURRENT LAND USE

Both the surface and ground watersheds of Fenner Lake are fairly small. The most common current land uses in the Fenner Lake Surface Watershed are non-irrigated agriculture and woodlands. In the ground watershed, woodlands dominate (See Figures 5, 6a, 6b & 7).

Figure 5: Fenner Lake Watersheds Land Use in Acres and Percent of Total

	Surface		Ground		Total	
Fenner Lake						
Agriculture--Non Irrigated	180.73	25.79%	104.78	16.90%	285.51	21.62%
Agriculture--Irrigated	94.81	13.53%	70.93	11.44%	165.74	12.55%
Government	0	0.00%	11.28	1.82%	11.28	0.85%
Grassland/Pasture	28.76	4.10%	0	0.00%	28.76	2.18%
Residential	34.9	4.98%	40.3	6.50%	75.2	5.69%
Water	55.43	7.91%	0	0.00%	55.43	4.20%
Woodland	306.13	43.69%	392.71	63.34%	698.84	52.91%
total	700.76	100.00%	620	100.00%	1320.76	100.00%

Studies have shown that land use around a lake has a great impact on the water quality of that lake, especially in the amount and content of surface runoff. (James, T., 1992, I-10; Kibler, D.F., ed. 1982. 271) For example, while natural woodland may (on the average) absorb 3.5" out of a 4" rainfall, leaving only .5" as runoff, a residential area with quarter-acre lots may absorb only 2.3" of the 4", leaving 1.7" to run off the land into the lake—the same amount as may be expected to run off from a corn or soybean field. 1.7" of runoff translates into 46,200 gallons per acre ending up in the lake! Percentage of impervious surface, the soil type, vegetation present and slope of the site can all affect runoff volume. (Frankenberger, J, ID-230).

Surface Watershed Land Use--Fenner Lake

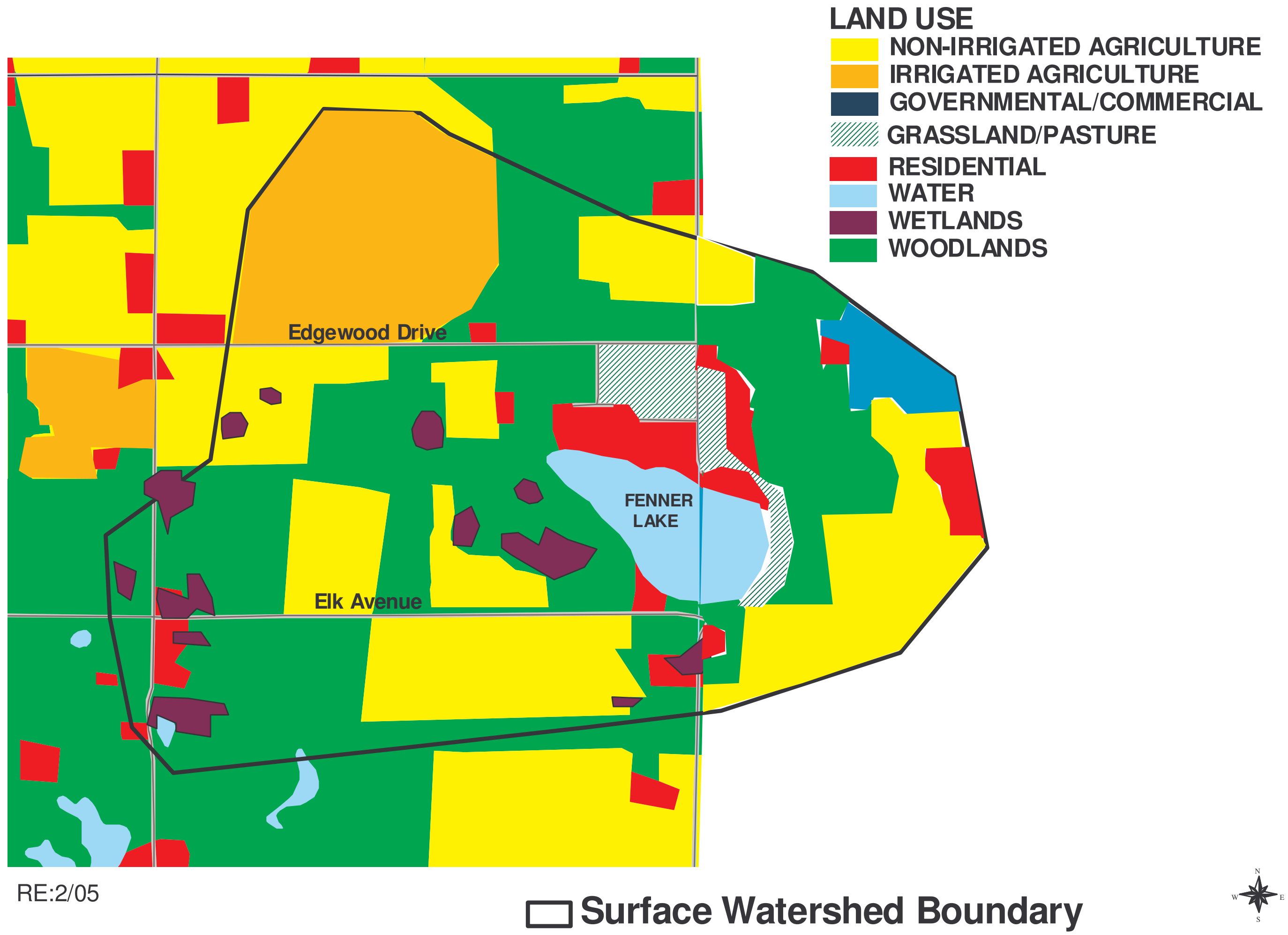


Figure 6a: Land Use in Fenner Lake Surface Watershed

Fenner Lake Ground Watershed Land Use

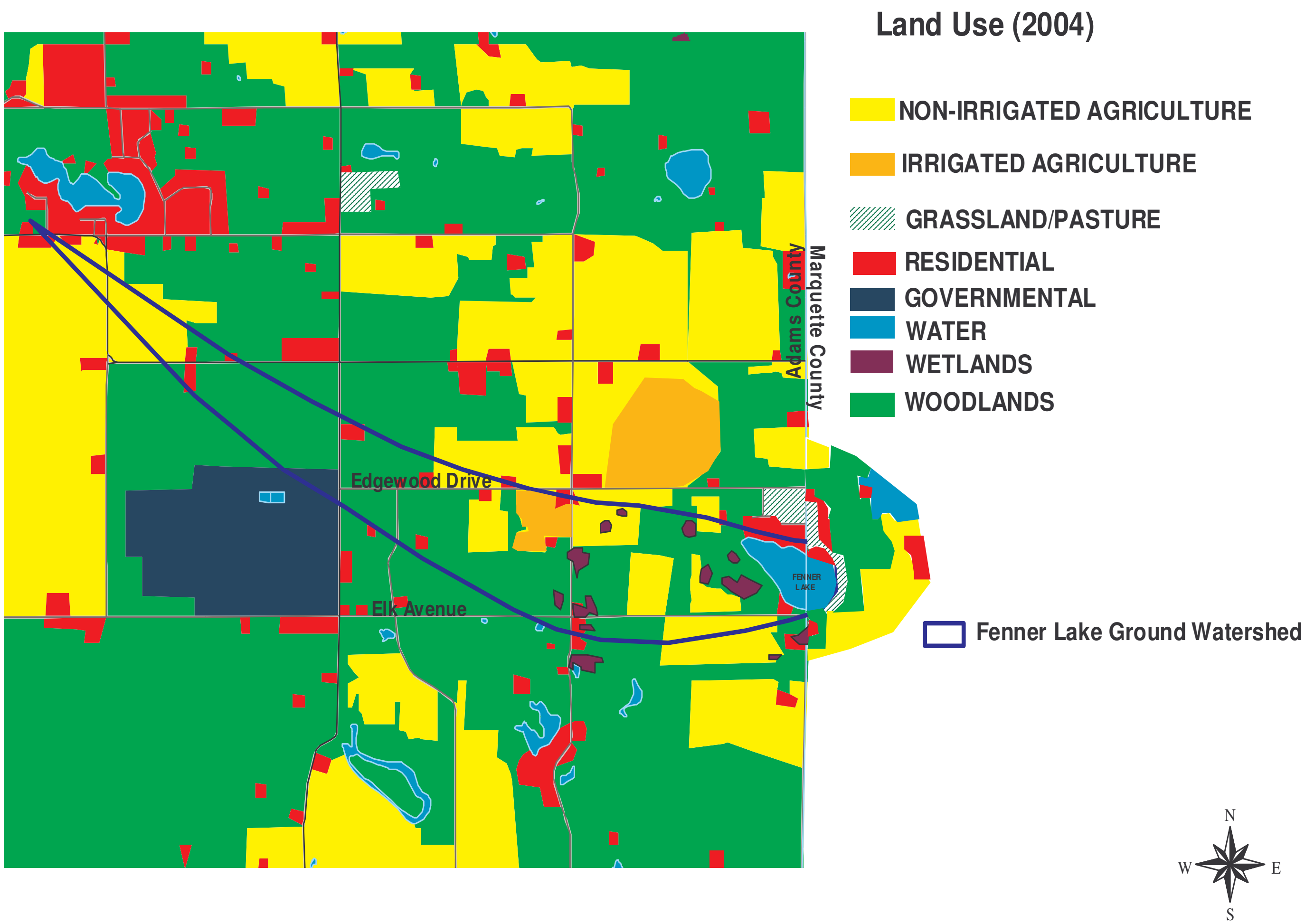


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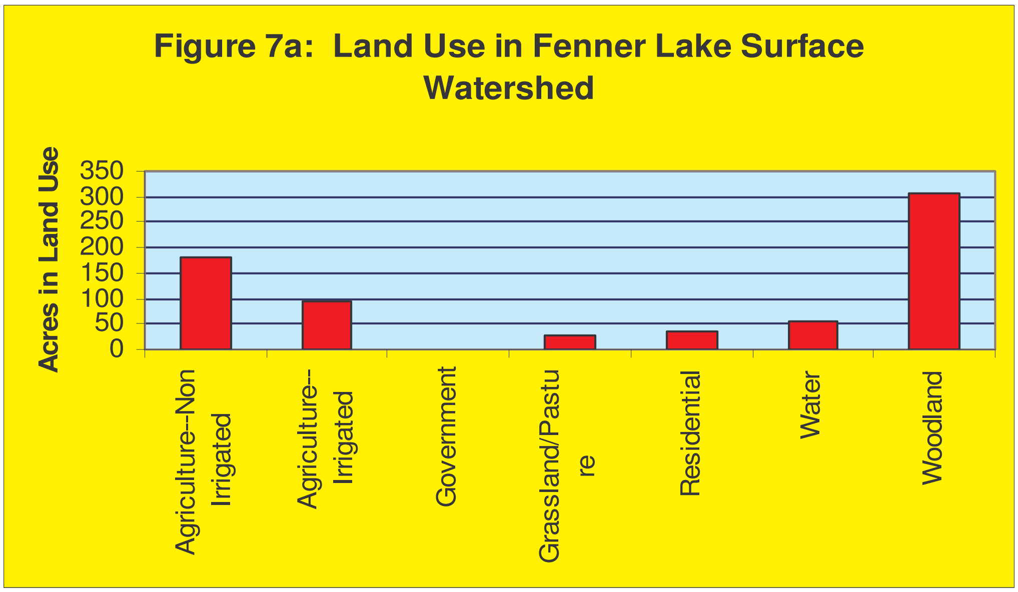
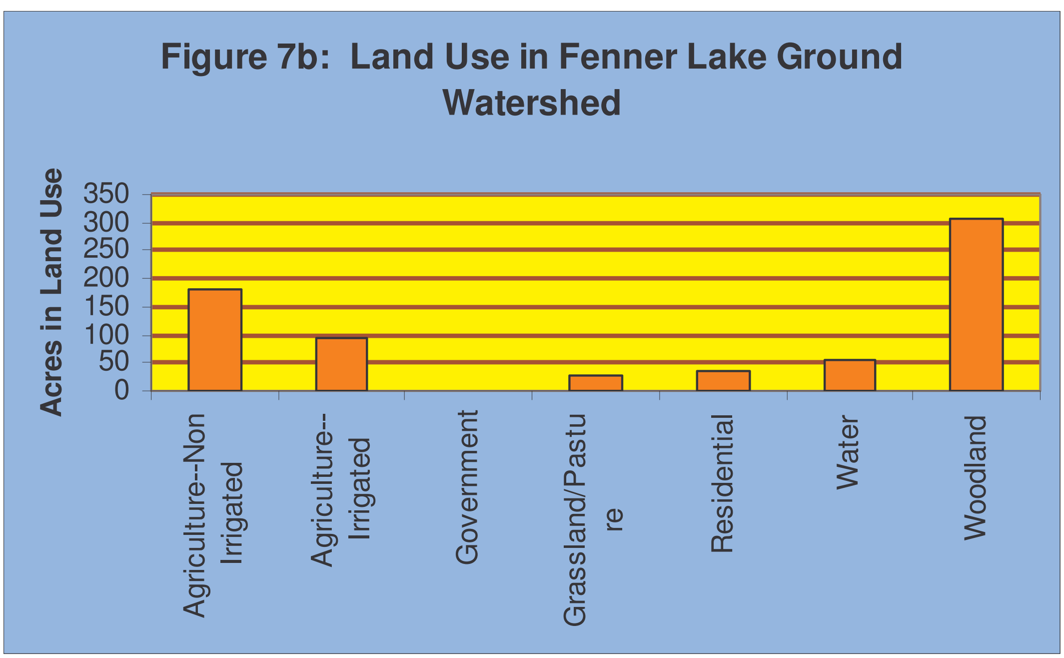
Figure 6b: Land use in Fenner Lake Ground Watershed

When water runs over a surface, it picks up whatever loose pollutants—sediment, chemicals, metals, exhaust gas, etc—are present on that surface and takes those items with it into the lake. Increased development around a lake tends to increase the amount of pollutants being carried into the lake, thus negatively affecting water quality. Residential development areas with lots of one-quarter acre or less may deliver as much as 2.5 pounds of phosphorus per year to the lake for each acre of development.





There are two specific kinds of land use—wetlands and shorelands--that are so important to water quality that they will be separately discussed.

WETLANDS

The wetlands located in the Fenner Lake surface and ground watersheds (Figures 6a & 6b) are scattered. Although the maps don't show it, there are also wetlands scattered around Fenner Lake's shores. In the past few years, as the lake level has declined, these wetlands have become exposed and are slowly drying out, unless the lake level comes back up to cover these areas. Formerly, wetlands were seen as "wasted land" that only encouraged disease-transmitting insects. Many wetlands were drained and filled in for cropping, pasturing, or even residential development. In the last few decades, however, the importance of wetlands has become evident, even as wetlands continue to decline in acreage.

Wetlands play an important role in maintaining water quality by trapping many pollutants in runoff and flood waters, thus often helping keep clean the water they connect to. They serve as buffers to catch and control what would otherwise be uncontrolled water and pollutants. Wetlands also play an essential role in the aquatic food chain (thus affecting fishery and water recreation), as well as serving as spaces for wildlife habitat, wildlife reproduction and nesting, and wildlife food.

Figure 8: former shoreland wetland area on Fenner Lake now exposed

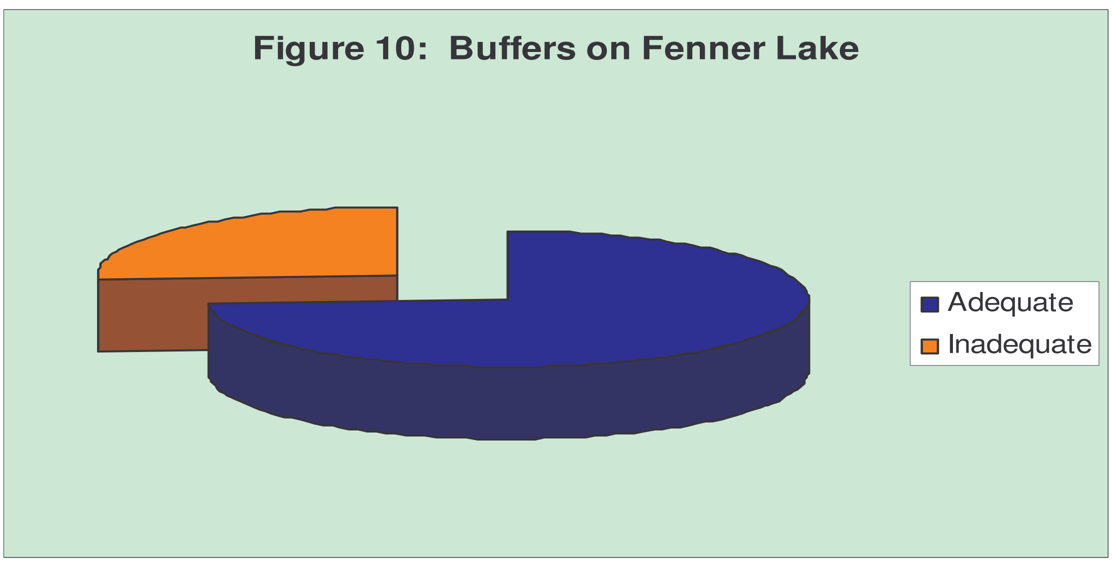
SHORELANDS

Fenner Lake has a total shoreline of 1.0 miles (5280 feet). About half of the immediate shore area is in residential use (some residences are not visible on the aerial photo below due to heavy tree establishment. Much of the area near the shore is steeply sloped. Buildings are generally located 70 or more feet back from the shore. 76.5% of Fenner Lake's shoreline is vegetated. Several areas of the shore, especially at the east end, have significant erosion currently occurring.

Figure 9: Shoreline of Fenner Lake (2004)

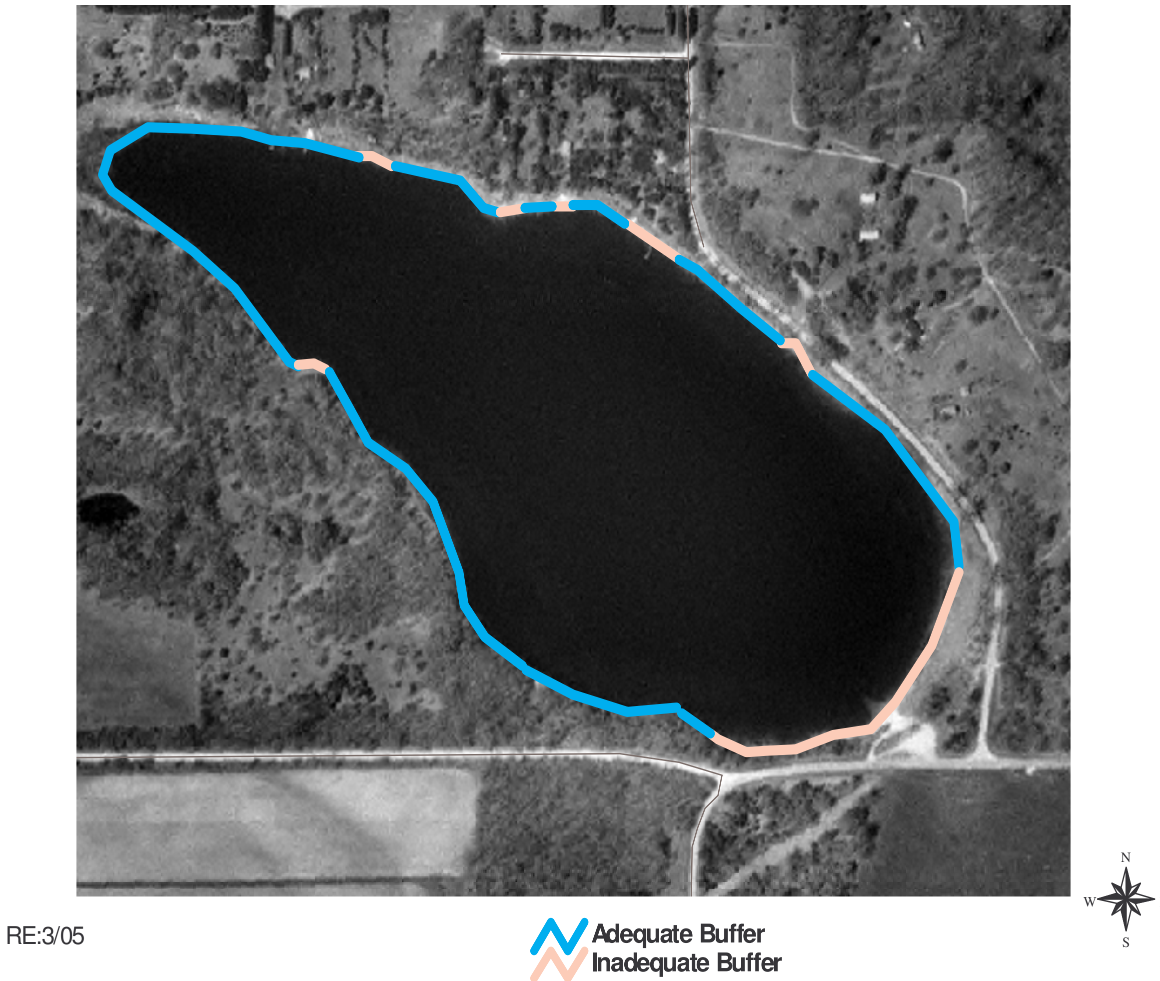
Under the Adams County Shoreland Ordinance, the first 35 feet landward from the water is a "buffer." Shoreland buffers are an important part of lake protection and restoration. These buffers are simply a wide border of native plants, grasses, shrubs and trees that filter and trap soil & similar sediments, fertilizer, grass clippings, stormwater runoff and other potential pollutants, keeping them out of the lake. A 1990 study of Wisconsin shorelines revealed that a buffer of native vegetation traps 5 to 18 times more volume of potential pollutants than does a developed, traditional lawn or hard-armored shore.

The 2004 inventory included classifying areas of the Fenner Lake shorelines as having "adequate" or "inadequate" buffers. An "adequate" buffer was defined as one having the first 35 feet landward covered by native vegetation. An "inadequate" buffer was anything that didn't meet the definition of "adequate buffer", including native vegetation strips less than 35 feet landward. Using these definitions, 71.47% (about 3916 feet) of Fenner Lake's shoreline had an "adequate buffer", leaving 25.83% (1364 feet) as "inadequate." Most of the "inadequate" buffer areas were found with l mowed lawns and/or insufficient native vegetation at the shoreline to cover 35 feet landward from the water line.



Vegetated shoreland buffers help stabilize shoreline banks, thus reducing bank erosion. The plant roots give structure to the bank and also increase water infiltration and decrease runoff. A vegetated shore is especially important when shores are sandy and soft, as are many of the Fenner Lake shores. Figure 11 maps the adequate and inadequate buffers on Fenner Lake.

Figure 11: Buffer on Fenner Lake (2004)



Lakeside buffers also serve as important habitat. Lake edges usually contain aquatic and wetland plants, grading into drier groundcover, then shrubs and trees as one moves inland towards drier land. Buffers provide habitat for many species of water-dependent wildlife, including furbearers, reptiles, birds and insects. Many wildlife species, including birds, small mammals, fish & turtles breed, nest, forage and/or perch in shore buffer areas. Further, 80% of the endangered and threatened species listed spend part of their life in this near-lake buffer area. (Wagner et al, 2006)

Figure 12a: Example of Inadequate Buffer

Figure 12b: Example of Adequate Buffer

When the natural shoreline is replaced by mowed turf-grass lawns, rock, wooden walls or similar installments, bird and animal life, land-based insects, and aquatic insects that hatch or winter on natural shore are negatively impacted. For example, on many Adams County lakes, the non-native aquatic plant, Eurasian Watermilfoil has invaded. There is a weevil native to Wisconsin that weakens Eurasian Watermilfoil by burrowing into and developing within its stems, but that weevil depends on a native-plant shore to overwinter. If the shore is instead covered by rock, seawall or traditional lawn, these weevils will be unavailable for the lake to use as Eurasian Watermilfoil control.

The filtering process and bank stabilization that buffers provide help improve a lake's water quality, including water clarity. Studies in Minnesota, Maine and Michigan have shown that waterfront property value increases for every foot the water clarity of a lake increases. (Krysel et al, 2003).

Natural shoreland buffers serve important cultural functions. They enhance the lake's aesethics. Studies have shown that aeshetics rank high as one of the reasons people visit or live on lakes. Shore buffers can provide visual & audio privacy screens for homeowners from other neighbors and/or lake users.

Adequate buffers on Fenner Lake could be easily installed on most of the lake by either letting the first 35 feet landward from the water just grow without mowing it, except for a path to the water, or—if something more controlled or aesthetically pleasing was desired—by planting native seedlings sufficient to fill in the first 35 feet.

The boat ramp and small beach area are located in Marquette County. They are basically a soft, fairly steep, very sandy slope prone to both water and wind erosion. Steps should be taken to protect this shore from further erosion. If appropriately done, this would also keep some soil particles from ending up in the lake.

Figure 13: Example of Vegetated Shore on Fenner Lake

WATER QUALITY

Between 2004 and 2006, Adams County Land & Water Conservation Department gathered water chemistry and other water quality information on 20 lakes in Adams County with public access. Fenner Lake was one of these lakes. Part of the information was gained from periodic water sampling done by Adams County LWCD. Historic information about water testing on Fenner Lake was also obtained from the WDNR (1992).

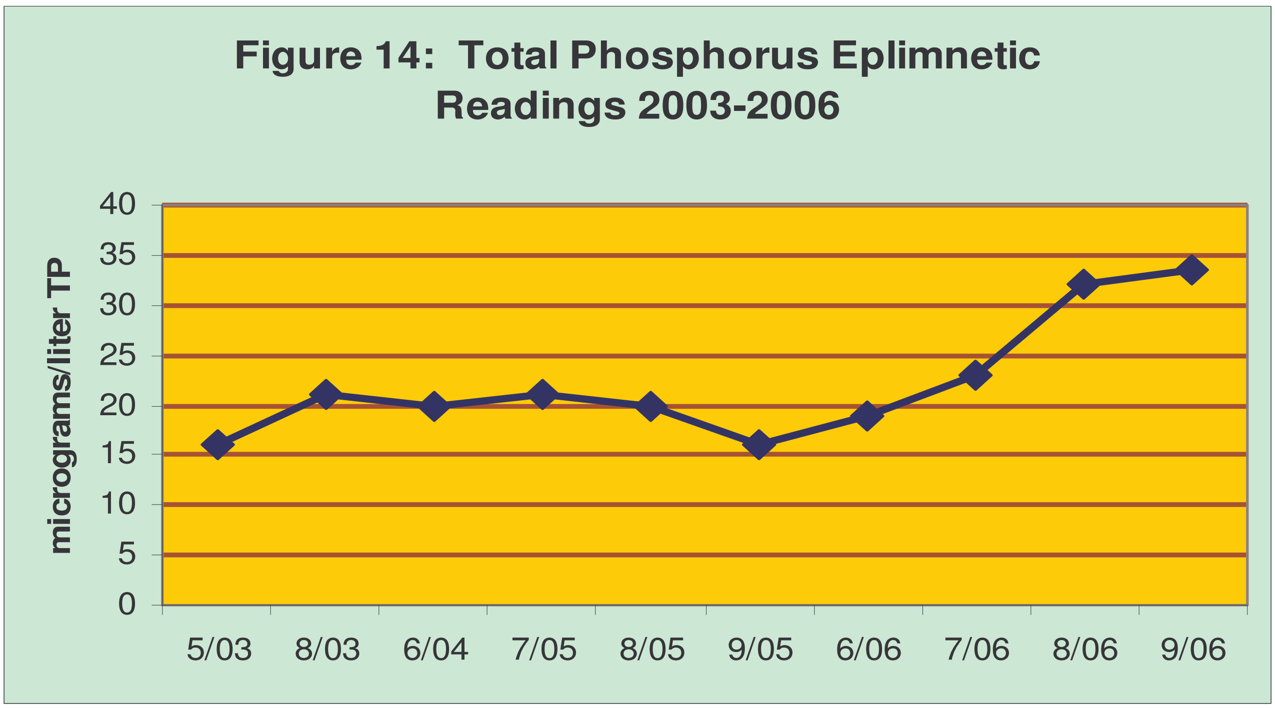
Phosphorus

Most lakes in Wisconsin, including Fenner Lake, are phosphorus-limited lakes: of the pollutants that end up in the lake, the one that most affects the overall quality of the lake water is phosphorus. The amount of phosphorus especially affects the frequency and density of aquatic vegetation and the frequency and density of various kinds of algae, as well as water clarity and other quality aspects. One pound of phosphorus can produce as much as 500 pounds of algae.

Phosphorus is not an element that occurs in high concentration naturally, so any lake that has significant phosphorus readings must have gotten that phosphorus from outside the lake or from internal loading. Some phosphorus is deposited onto the lake from atmospheric deposition, especially from soil or other particles in the air carrying phosphorus. A lake that includes a flooded wetland area may have a significant amount of phosphorus being released during the flushing of the wetland area. Phosphorus may accumulate in sediments from dying animals, dying aquatic plants and dying algae. If the bottom of the lake becomes anoxic (oxygen-depleted) or hypoxic (low oxygen), chemical reactions may cause phosphorus to be released into the water column.

Although there are several forms of phosphorus in water, the total phosphorus (TP) concentration is considered a good indicator of a lake's nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For a natural lake like Fenner Lake, a total phosphorus concentration below 20 micrograms/liter tends to reduce nuisance algal blooms. Fenner Lake's growing season (June-September) water column average total phosphorus level of 17.39 micrograms/liter is below that level. If nuisance algal blooms have occur on Fenner Lake, as they have recently, they were perhaps aggravated by the hot still weather for the summers of 2006 and 2007.

The limiting factor in most Wisconsin lakes, including Fenner Lake, is phosphorus. Measuring the phosphorus in a lake system thus provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth. The 2004-2006 epilimnetic (surface) summer average phosphorus concentration in Fenner Lake was 21.42 micrograms/liter. As the graph below (Figure 14) shows, eplimnetic total phosphorus levels stayed fairly steady until the late summer of 2006, when the weather was very hot and still for several weeks. The average of 21.42 micrograms/liter is below the 25 micrograms/liter average for natural lakes in Wisconsin. This concentration suggests that Fenner Lake is likely to have few nuisance algal blooms. This places Fenner Lake in the "good" level for phosphorus.



A comparison of the average summer phosphorus level in the lower depths of Fenner Lake (15' and deeper) to the upper depths (surface) shows that average total phosphorus concentrations during the summer months are 36.4 micrograms/liter for 15' depth and below and 27.9 micrograms/liter. This situation should be monitored, because in some of the natural lakes in Adams County, the lower depths are serving as phosphorus "sinks", adding to the phosphorus in the sediment that may become available to plants and algae in the water column.


Mixed High-Density
Hard Sediment Types
Mixed Soft
Sediment Types
Sand – A High-Density
Hard Sediment
Mixed Hard and
Soft Sediment Types
Intermediate-Density
Silt Sediment most
favorable for plant
growth.
Peat – Flocculent Sediment

Groundwater testing of various wells around Fenner Lake was done by Adams County LWCD and included a test one year (2006) for total phosphorus levels in the groundwater coming into the lake. The average TP level in the wells tested was 14.2 micrograms/liter, somewhat lower than the lake surface water results. This phosphorus may also seep into Fenner Lake, although if the level is always that low, it wouldn't be a significant contributor of phosphorus.

Land use plays a major role in phosphorus loading. A key component of the computer models used is the phosphorus budget, that is, the estimated amount of phosphorus delivered to the lake from each land use type annually. The land uses that contribute the most phosphorus are non-irrigated agriculture and irrigated agriculture. Using the current land use data, as well as phosphorus readings from 2004 through 2006 water sampling, a phosphorus loading prediction model was run for Fenner Lake. The current results are shown in the table below:

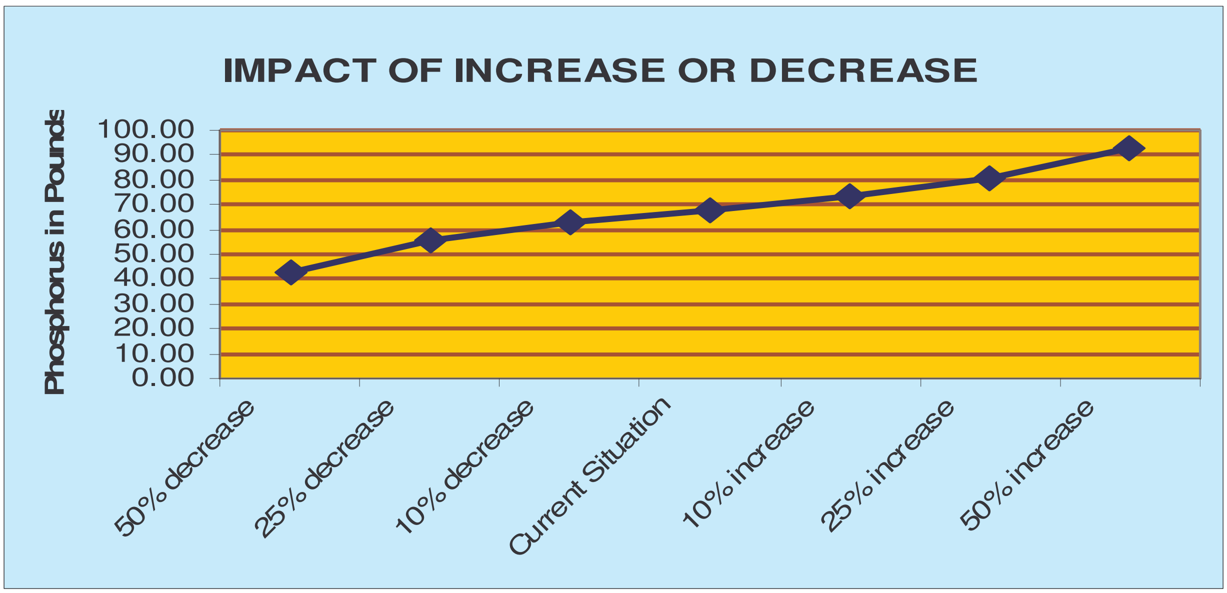
Figure 16: Current Phosphorus Loading by Land Use

MOST LIKELY PHOSPHORUS LOADING		
	% of Loading	**P in lbs/acre/yr**
Agriculture--Irrigated	38.3%	16.95
Agriculture--Non Irrigated	25.1%	25.87
Grassland/Pasture	2.3%	1.78
Residential	1.1%	0.89
Woodlands	8.1%	5.35
Other Water	1.7%	0.89
Ground Watershed	16.4%	11.60
Lake Surface	2.7%	1.78
Septics	4.3%	2.94
	100.0%	68.05

Phosphorus deposits such as that from flooded wetlands or from atmospheric deposition cannot be controlled by humans. However, some phosphorus (and other nutrient) input can be decreased or increased by changes in human land use patterns. Practices such as shoreland buffer restoration; infiltrating stormwater runoff from roof tops, driveways and other impervious surfaces; using no phosphorus lawn fertilizers; and reducing phosphorus input to and properly managing septic systems will minimize phosphorus inputs into the lake. Circumstances such as increased impervious surface, lawns mowed to water's edge, disturbance of shore areas, improperly-functioning septic systems and removal of native vegetation can greatly increase the volume and content of runoff—and thus increase the <u>volume</u> of phosphorus entering the lake. Many of these practices can also increase the <u>concentration</u> of phosphorus entering the lake, by runoff or other methods of entry.

The models were run using not only the current known phosphorus readings in the lake, but also representing decreases or increases of human-controlled phosphorus input by 10%, 25%, and 50%. The figures may not seem like much---until you calculate that one pound of phosphorus can result in up to 500 pounds of algae. A 10% reduction in these three areas could result in 2500 pounds less of algae per acre per year!

Figure 17: Impact of Changes in Overall Phosphorus Input



Looking at this issue in terms of how much phosphorus readings in the lake might change, based on the computer modeling, in-lake perhaps makes it clearer. Figure 18 shows that the effect of 10% and 25% decrease to human-impacted phosphorus within the lake.

Reducing the amount of input from the surface and ground watersheds results in less nutrient loading into the lake itself. Under the modeling predictions, reducing phosphorus inputs from human-based activities even 10% would improve Fenner Lake water quality by 1.6 to 3 micrograms of phosphorus/liter; a 25% reduction would save 6 to 9 micrograms/liter (see Figure 18). This kind of reduction would decrease the likelihood of algal blooms and might assist in reducing aquatic plant density. These predictions make it clear that reducing current phosphorus inputs to the lake are essential to improve, maintain and protect Fenner Lake's health for future generations.

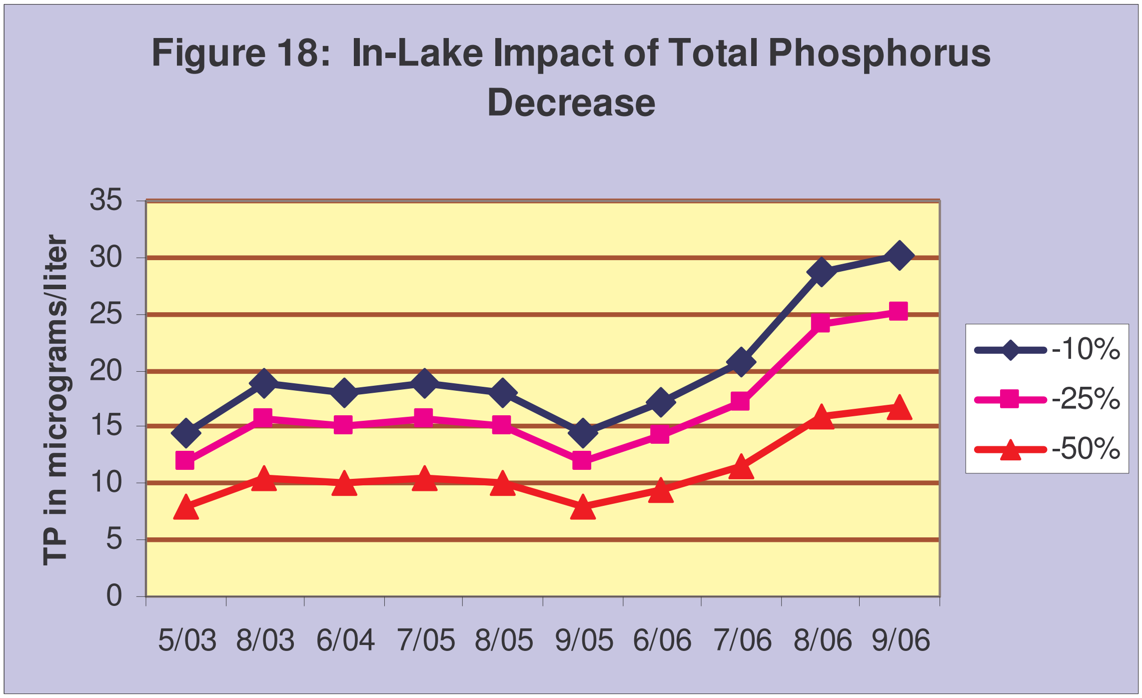


Figure 19: Photo of a Lake with Algal Bloom

Water Clarity

Water clarity is a critical factor for plants. If plants don't get more than 2% of the surface illumination, they won't survive. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water. Water clarity is measured with a Secchi disk. Average summer Secchi disk clarity in Fenner Lake in 2004-2006 was 9.66 feet. This is very good water clarity, putting Fenner Lake into the "oligotrophic" category for water clarity.

Figure 20: Average Summer Secchi Disk Readings in Fenner Lake

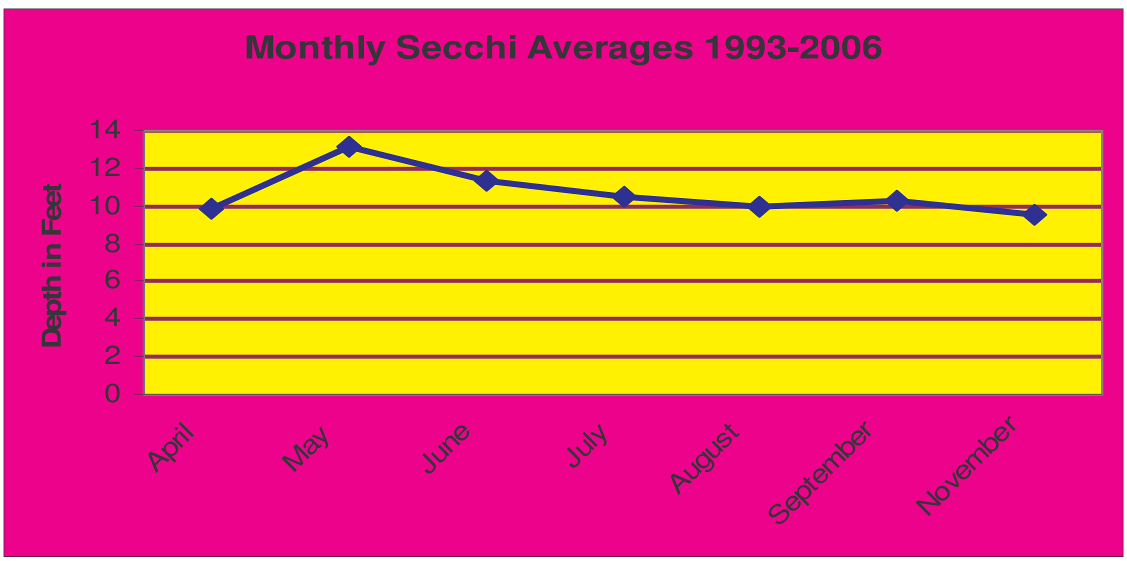


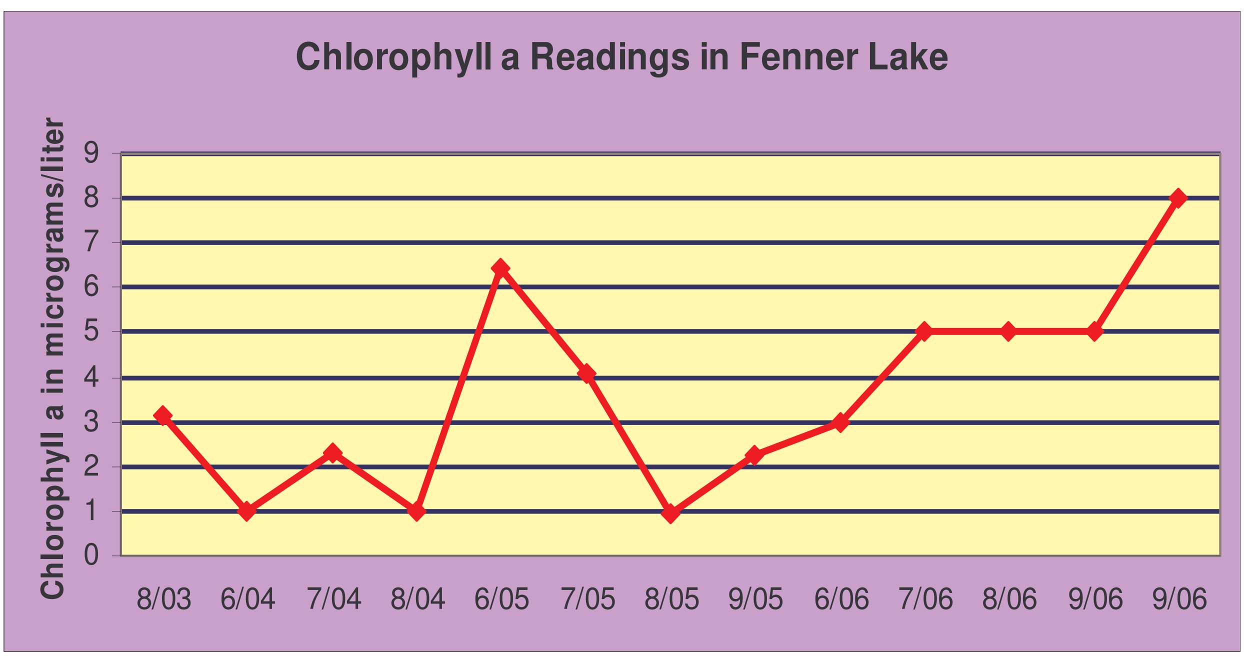
Figure 21: Photo of Testing Water Clarity with Secchi Disk

Chlorophyll a

Chlorophyll-a concentrations provide a measurement of the amount of algae in a lake's water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth, as well as result in unpleasing odor and appearance. Studies have shown that the amount of chlorophyll a in lake water depends greatly on the amount of algae present; therefore, chlorophyll-a levels are commonly used as a water quality indicator. The 2004-2006 summer (June-September) average chlorophyll concentration in Fenner Lake was 3.2 micrograms/liter This low algae concentration places Fenner Lake at the "oligotrophic" level for chlorophyll a results.

Chlorophyll-a averages have stayed low since 2003, the first year for which records were found, and have remained very low between 2004 and 2006, when the Adams County LWCD was monitoring the lake.

Figure 22: Summer Chlorophyll-a Averages

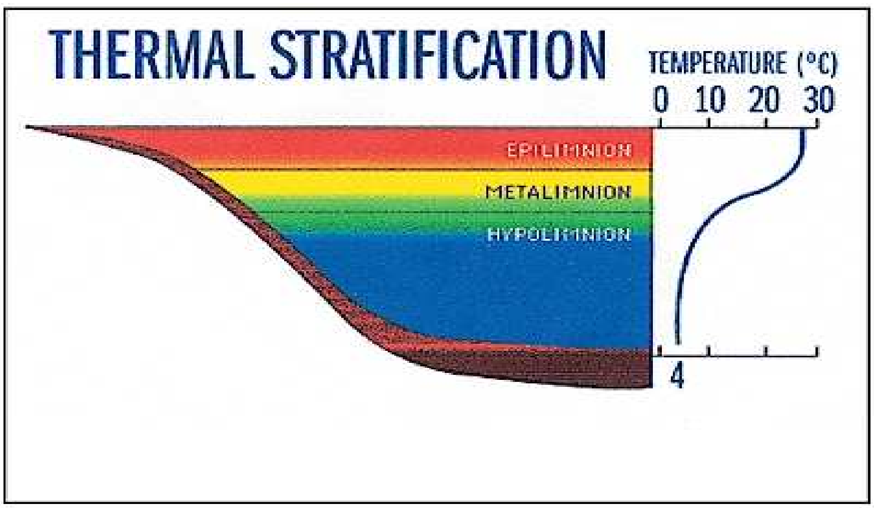


Dissolved Oxygen

Oxygen dissolved in the water is essential to all aerobic aquatic organisms. The oxygen in a lake comes from the atmosphere and from the process of photosynthesis. Aquatic plants and algae consume carbon dioxide and respirate oxygen back into the lake water. The distribution of oxygen within a lake is affected by many factors, including water circulation, water stratification, winds or storms, air temperature; water temperature, nutrient availability, and the density and location of algae and/or aquatic plants.

Oxygen consumption in the sediment and the water just above it (hypolimnion) is more sensitive that those in the two upper layers of water (metalimnion and epilimnion) because the bottom consumption is less likely to be balanced by the circulation and photosynthesis output available to the upper layers.

Figure 23: Lake Stratification Layers



Low oxygen during the summer in the bottom waters of a lake occurs naturally as oxygen in the bottom layer is consumed, but not replenished. It is common that as the summer progresses, the oxygen concentration of the bottom waters decreases. In Fenner Lake, there were hypoxic periods in the depths from 20' to 50' during the summers of 2004 and 2005. By August 2005, dissolved oxygen concentration at bottom depth was only 2.2 mg/l. In 2004, by September, dissolved oxygen concentration at the bottom was 1.2 mg/l. This pattern was not present in 2006 when oxygen levels at all depths were over 5 mg/l (the minimum level for most fish survival).

The charts (Figures 24a, b, c) below show the annual (2004-2006) variations in dissolved oxygen levels in milligrams/liter, depth in feet and months of the year:

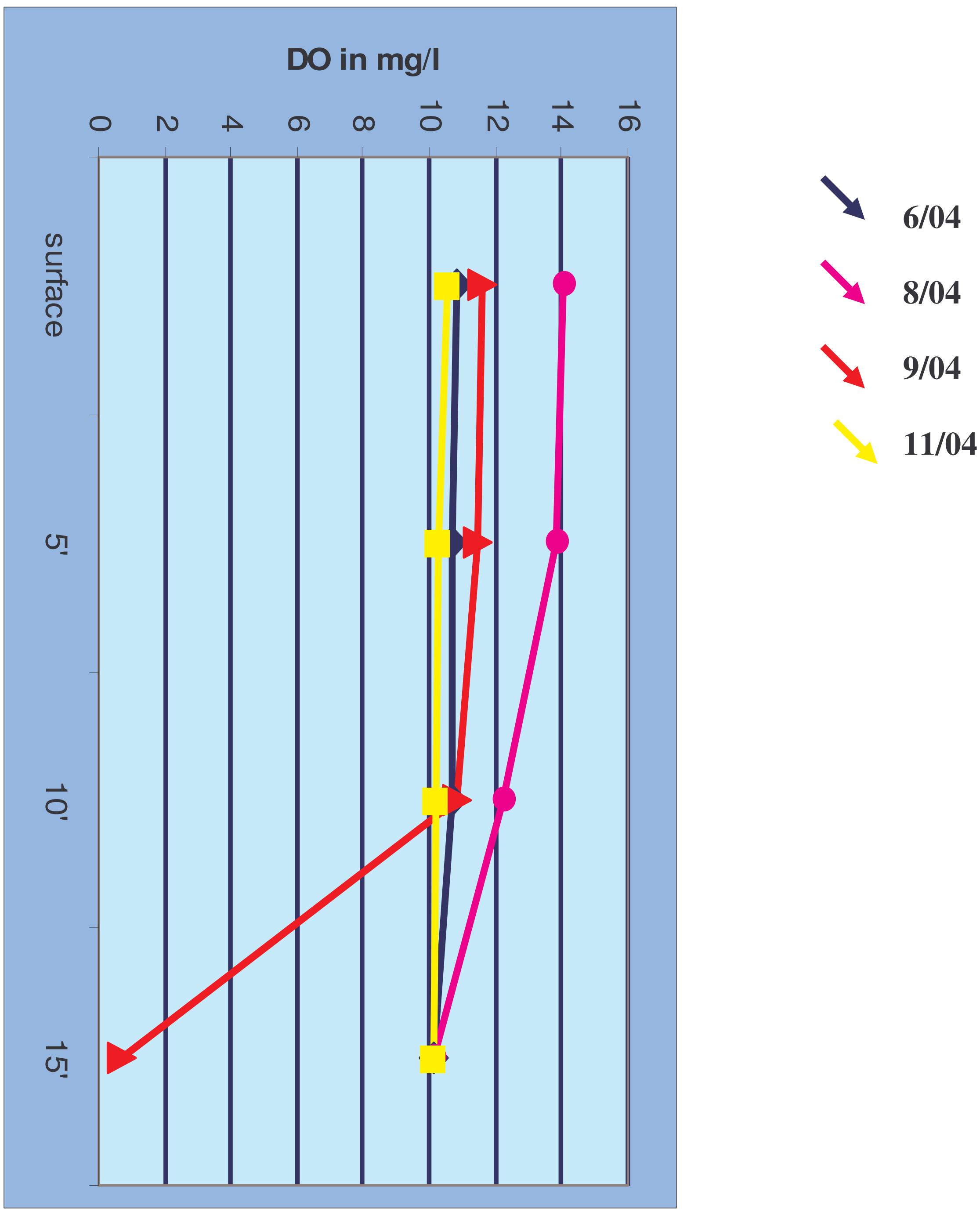
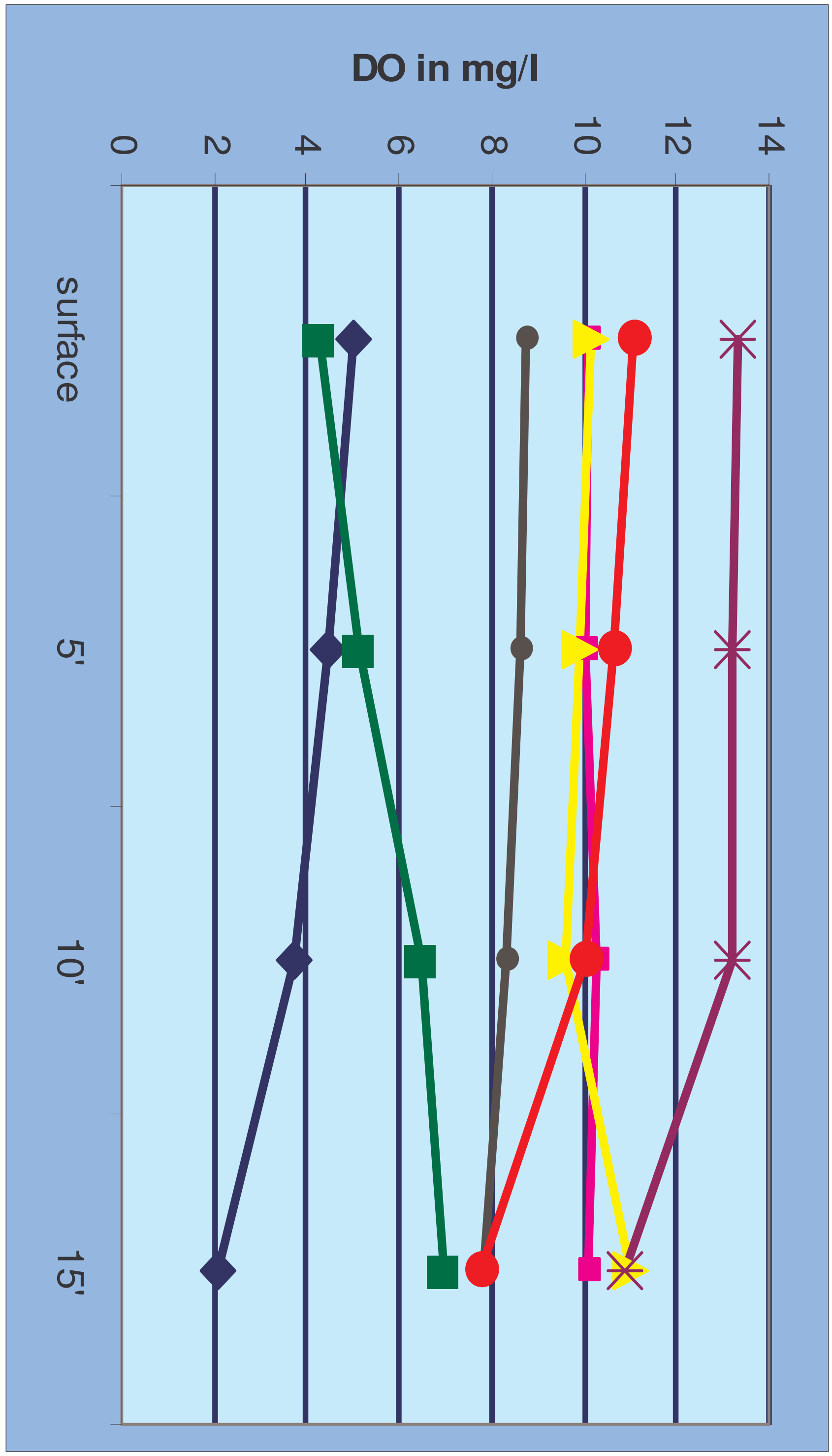


Figure 24b: Dissolved Oxygen Levels During 2005 Water Testing in milligrams/liter



2/05

4/05

6/05

7/05

8/05

9/05

11/05

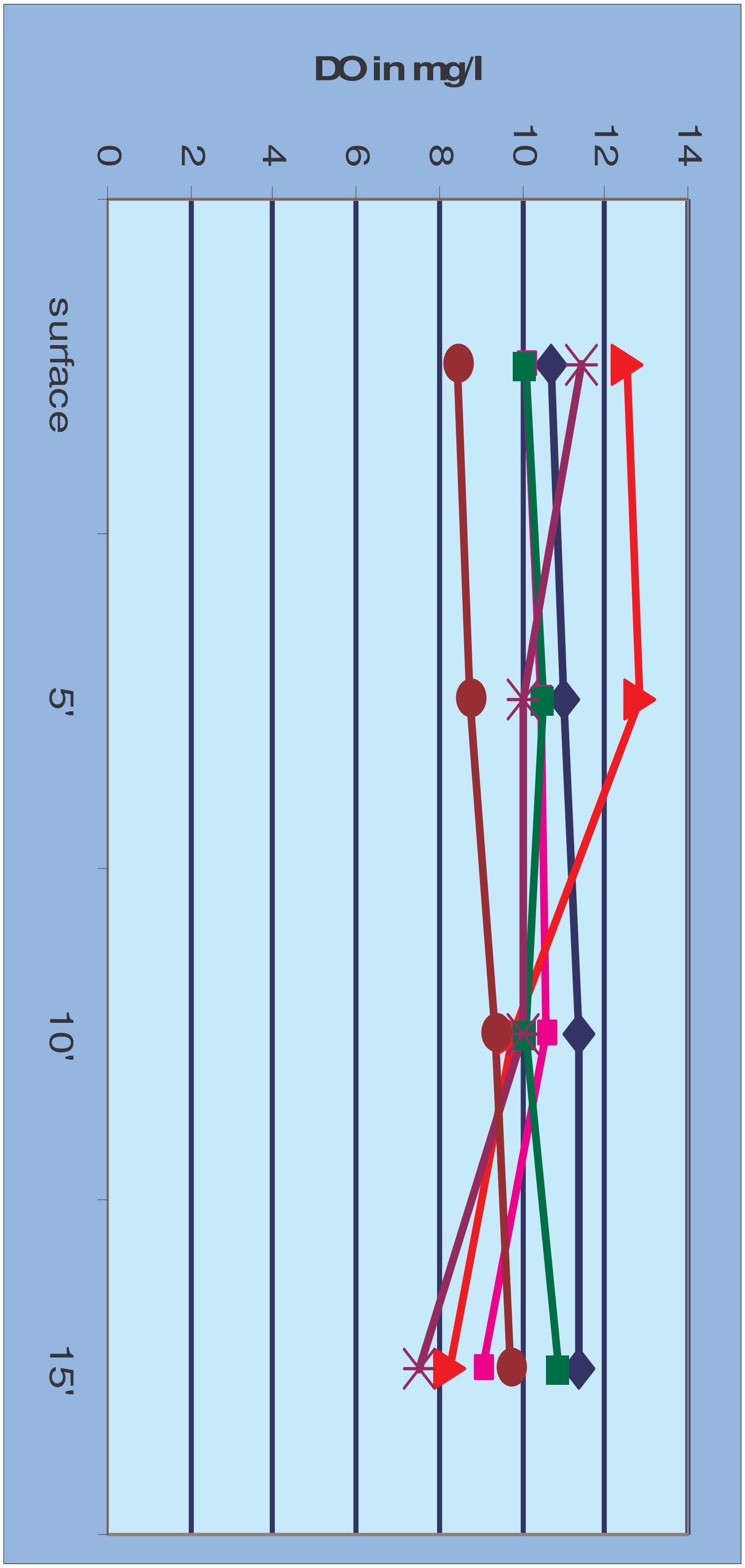


Figure24c: Dissolved Oxygen Levels During 2006 Water Testing in milligrams/liter

4/06

6/06

7/06

8/06

9/06

9/06

By autumn, when the surface waters have cooled and water density throughout the water column is the same, the water column mixes vertically, a process known as “fall turnover.”

Human activity can aggravate the development of low oxygen (hypoxic) or no oxygen (anoxic) in the bottom waters. For example, the addition of phosphorus usually leads to an increase in the growth of algae and aquatic plants—both of which consume oxygen during their photosynthesis. It has also been hypothesized that hypoxia or anoxia can be affected by climate changes, such as a longer and/or warmer summer, low lake levels, and changes in water temperature due to cover (i.e., shore vegetation) being removed.

The development of hypoxia or anoxia can have negative effects. The first effect usually noticed by human is fish kills. Fish kills result when fish species that need cold oxygen-rich water to survive can’t find it in the lake anymore or when some of their invertebrate food (such as mayfly nymphs) is gone due to low oxygen levels. Another noticeable effect can be an increase in the frequency and distribution of algal blooms. In some instances, anoxia can lead to blooms of toxic algae and the production of water-borne toxins that can harm humans and wildlife. Anoxia sometimes also leads to increased phosphorus cycling, undesirable water taste or odor levels, and interference with recreational uses such as swimming, boating and fishing.

As noted above, summer hypoxia or anoxia can result in phosphorus being released into the upper water column and being available for algal blooms and increased aquatic plant growth. The results from 2004 through 2006 (the only years for which data is available) don’t show that summer hypoxia/anoxia in the lower depths is always a problem in Fenner Lake, but it did show up in two of the three years.

The data from 2004-2006 (see Figures 24a, b, c) shows there is potential for phosphorus loading from the lower depths (hypolimnion) during the summer months in Fenner Lake if the hypoxia/anoxia continues. Dissolved oxygen needs to be monitored during the late summer months in the lower depths on Fenner Lake to determine whether hypoxia/anoxia is a frequently-occurring condition that may need to be addressed by management practices.

Water Hardness, Alkalinity and pH

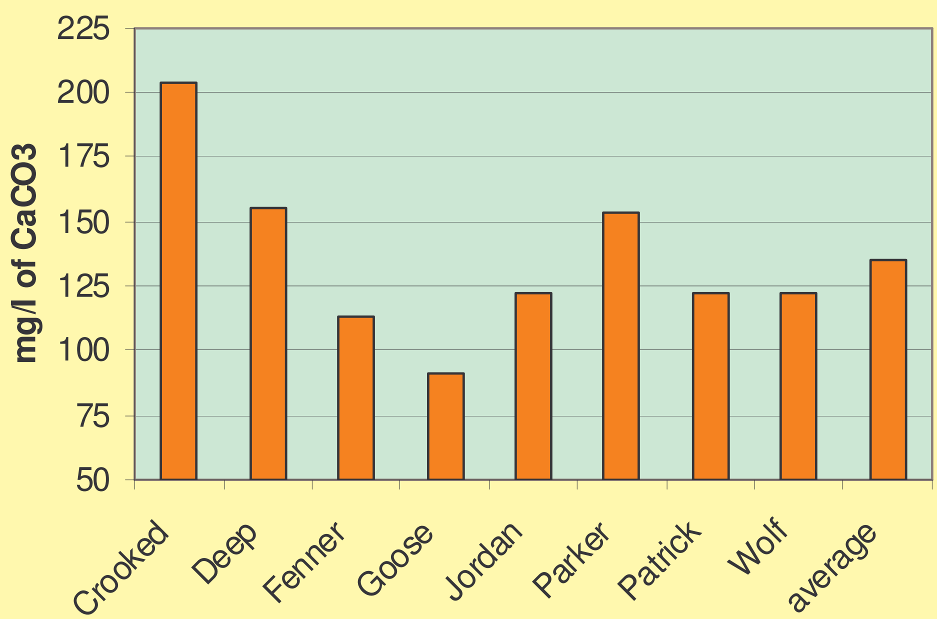
Testing done by Adams County LWCD on Fenner Lake included annual testing for water alkalinity and water hardness. Hardness and alkalinity levels in a lake are affected by the soil minerals, bedrock type in the watershed, and frequency of contact between lake water & these materials.

Level of Hardness	Mg/l CaCO3
SOFT	0-60
MODERATELY HARD	61-120
HARD	121-180
VERY HARD	>180

Figure 25: Levels of Hardness in Mg/l of Calcium Carbonate

One method of evaluating hardness is to test the water for the amount of calcium carbonate ($CaCO_3$) it contains. The surface water of all of the public access lakes in Adams County is moderately hard to very hard. In 2005 and 2006, random samples were also taken of wells around Fenner Lake to measure the hardness of the water coming into the lake through groundwater. Hardness in the groundwater ranged from 164 (hard) to 248 (very hard). The hardness in both surface and groundwater is likely due to the underlying bedrock in Adams County, which is mostly sandstone with pockets of dolomite and shale.

Figure 26: Hardness of Adams County Natural Lakes



As the graph (Figure 26) shows, Fenner Lake surface water testing results showed "hard" water" (178.3 mg/l of CaCO3), which is a higher hardness than the average for Adams County's natural lakes (135 mg/l of Calcium Carbonate). Hard water lakes tend to produce more fish and aquatic plants than soft water lakes because they are often located in watersheds with soils that load phosphorus into the lake water.

Alkalinity is important in a lake to buffer the effects of acidification from the atmosphere. "Acid rain" has long been a problem with lakes that had low alkalinity level and high potential sources of acid deposition.

Acid Rain Sensitivity	ueq/l CaCO3
High	0-39
Moderate	49-199
Low	200-499
Not Sensitive	>500

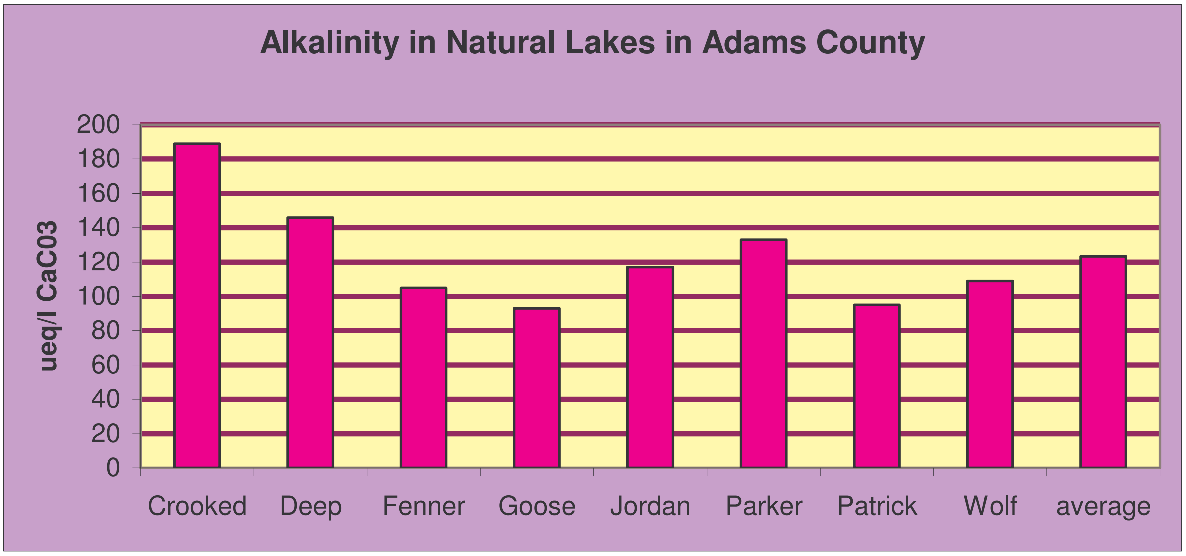
Figure 27: Acid Rain Sensitivity

Well water testing results ranged from 140 ueq/l to 235 ueq/l in alkalinity, with an average of 178.3 ueq/l, considerably higher than as the surface water results of average of 104.8 ueq/l. Fenner Lake's potential sensitivity to acid rain is moderate, but luckily for Adams County, the acid deposition rate is very low, probably due to the little industrialization in the county.

Alkalinity also affects the pH level of lake water. The acidity level of a lake's water regulates the solubility of many minerals. A pH level of 7 is neutral. The pH level in Wisconsin lakes ranges from 4.5 in acid bog lakes to 8.4 in hard water, marl lakes.

Some of the minerals that become available under low pH, especially the metals aluminum, zinc and mercury, can inhibit fish reproduction and/or survival. Even what seems like a small variance in pH can have large effects because the pH scale is set up so that every 1.0 unit change increases acidity tenfold, i.e., water with a pH of 7 is 10 times more acid than water with pH of 8. Mercury and aluminum are not only toxic to many kinds of wildlife; they can also be toxic to humans, especially those that eat tainted fish.

Figure 30: Graph of Natural Lake Alkalinity



The testing occurring from 2004-2006 also included regular monitoring of the pH at several depths in Fenner Lake. As is common in the lakes in Adams County, Fenner Lake has pH levels starting at just under neutral (6.35) at the bottom depth and increasing in alkalinity as the depth gets less, until the surface water pH averages 7.24. A lake's pH level is important for the release of potentially harmful substances and also affects plant growth, fish reproduction and survival. Most plants grow best at pH levels between 5.5 and 8.

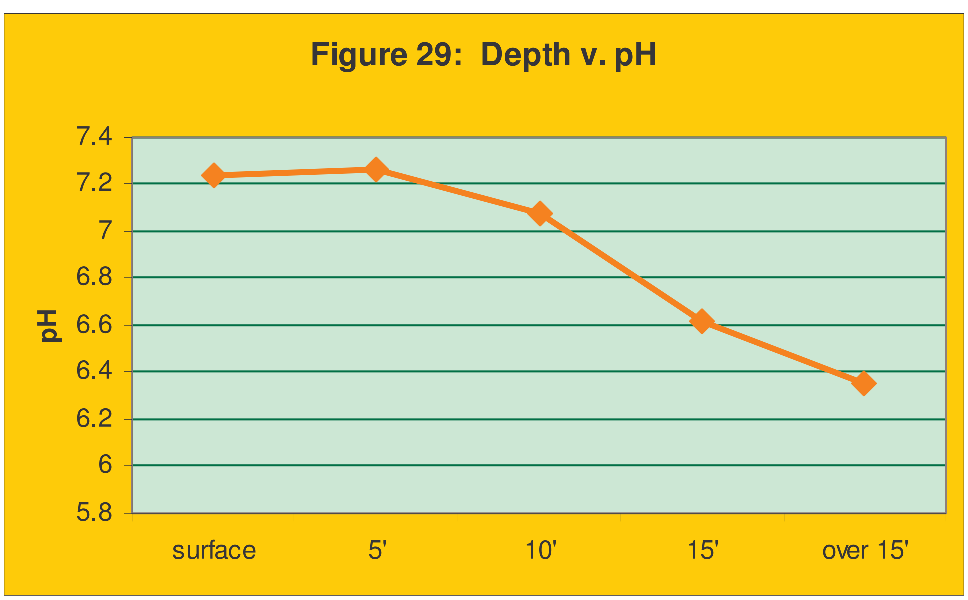


Figure 28: pH Average levels in Fenner Lake

More importantly for many lakes, fish reproduction and survival are very sensitive to pH levels. The chart below indicates the effect of pH levels under 6.5 on fish (Figure 28):

Figure 29: Effects of pH Levels on Fish

Water pH	Effects
6.5	walleye spawning inhibited
5.8	lake trout spawning inhibited
5.5	smallmouth bass disappear
5.2	walleye & lake trout disappear
5	spawning inhibited in most fish
4.7	Northern pike, sucker, bullhead, pumpkinseed, sunfish & rock bass disappear
4.5	perch spawning inhibited
3.5	perch disappear
3	toxic to all fish

A lake with a neutral or slightly alkaline pH like Fenner Lake is a good lake for fish and plant survival. Natural rainfall in Wisconsin averages a pH of 5.6. This means that if the rain falls on a lake without sufficient alkalinity to buffer that acid water coming in by rainfall, the lake's fish cannot reproduce. That is not a problem at Fenner Lake.

Figure 30: Abundant Fish in Fenner Lake: Bluegill

Other Water Quality Testing Results

CALCIUM and MAGNESIUM: Calcium is required by all higher plants and some microscopic lifeforms. Magnesium is needed by chlorophyllic plants and by algae, fungi and bacteria. Both calcium and magnesium are important contributors to the hardness of a lake's waters. Magnesium elevated about 125 mg/l may have a laxative effect on some humans. Otherwise, no health hazards to humans and wildlife are known from these elements. The average Calcium level in Fenner Lake's water during the testing period was 18.84 mg/l. The average Magnesium level was 12.98 mg/l. Both of these are low-level readings.

CHLORIDE: Chloride does not affect plant and algae growth and is not known to be harmful to humans. It isn't common in most Wisconsin soils and rocks, so is usually found only in very low levels in Wisconsin lakes. However, the presence of a significant amount of chloride over a period of time indicates there may be negative human impacts on the water quality present from septic system failure, the presence of fertilizer and/or waste, deposition of road-salt, and other nutrients. An increased chloride level is thus a possible indication that too many nutrients are entering the lake. The chloride levels found in Fenner Lake during the testing period averaged 1.38, well below the natural level of 3 mg/l of chloride in this area of Wisconsin.

NITROGEN: Nitrogen is necessary for plant and algae growth. A lake receives nitrogen in various forms, including nitrate, nitrite, organic, and ammonium. In Wisconsin, the amount of nitrogen in a lake's water often corresponds to the local land use. Although some nitrogen will enter a lake through rainfall from the atmosphere, that coming from land use tends to be in higher concentrations in larger amounts, coming from fertilizers, animal and human wastes, decomposing organic matter, and surface runoff. For example, the growth level of the exotic aquatic plant, Eurasian Watermilfoil (*Myriophyllum spicatum*) has been correlated with fertilization of lake sediment by nitrogen-rich spring runoff.

Nitrogen levels can affect other aspects of water quality. The sum of water testing results for nitrate, nitrite and ammonium levels of over .3 mg/l in the spring can be used to project the likelihood of an algal bloom in the summer (assuming sufficient phosphorus is also present). Fenner Lake combination nitrogen levels from 2004 to 2006 did rise to 1.3 mg/l, well above the .3 mg/l predictive level for algal blooms. Given appropriate conditions, Fenner Lake might suffer nitrogen-related algal blooms.

SODIUM AND POTASSIUM: These elements occur naturally only in low levels in Wisconsin waters and soils. Their presence may indicate human-caused pollution. Sodium is found with chloride in many road salts and fertilizers and is also found in human and animal waste. Potassium is found in many fertilizers and also found in animal waste. Increasing levels or one or both of these elements can indicate possible contamination from damaging pollutants. High levels of sodium have also been found to influence the development of a large population of cyanobacteria, some of which can be toxic to animals and humans. Both sodium and potassium levels in Fenner Lake are low: the average sodium level was 1.32 mg/l; the average potassium reading was .75 mg/l.

SULFATE: In low-oxygen waters (hypoxic), sulfate can combine with hydrogen and becomes the gas hydrogen sulfate (H2S), which smells like rotten eggs and is toxic to most aquatic organisms. Sulfate levels can also affect the metal ions in the lake, especially iron and mercury, by binding them up, thus removing them from the water column. To prevent the formation of H2S, sulfate levels of 10 mg/l are best. A health advisory kicks in at 30 mg/l. Fenner Lake sulfate levels averaged 3.24 mg/l during the testing period, far below either level.

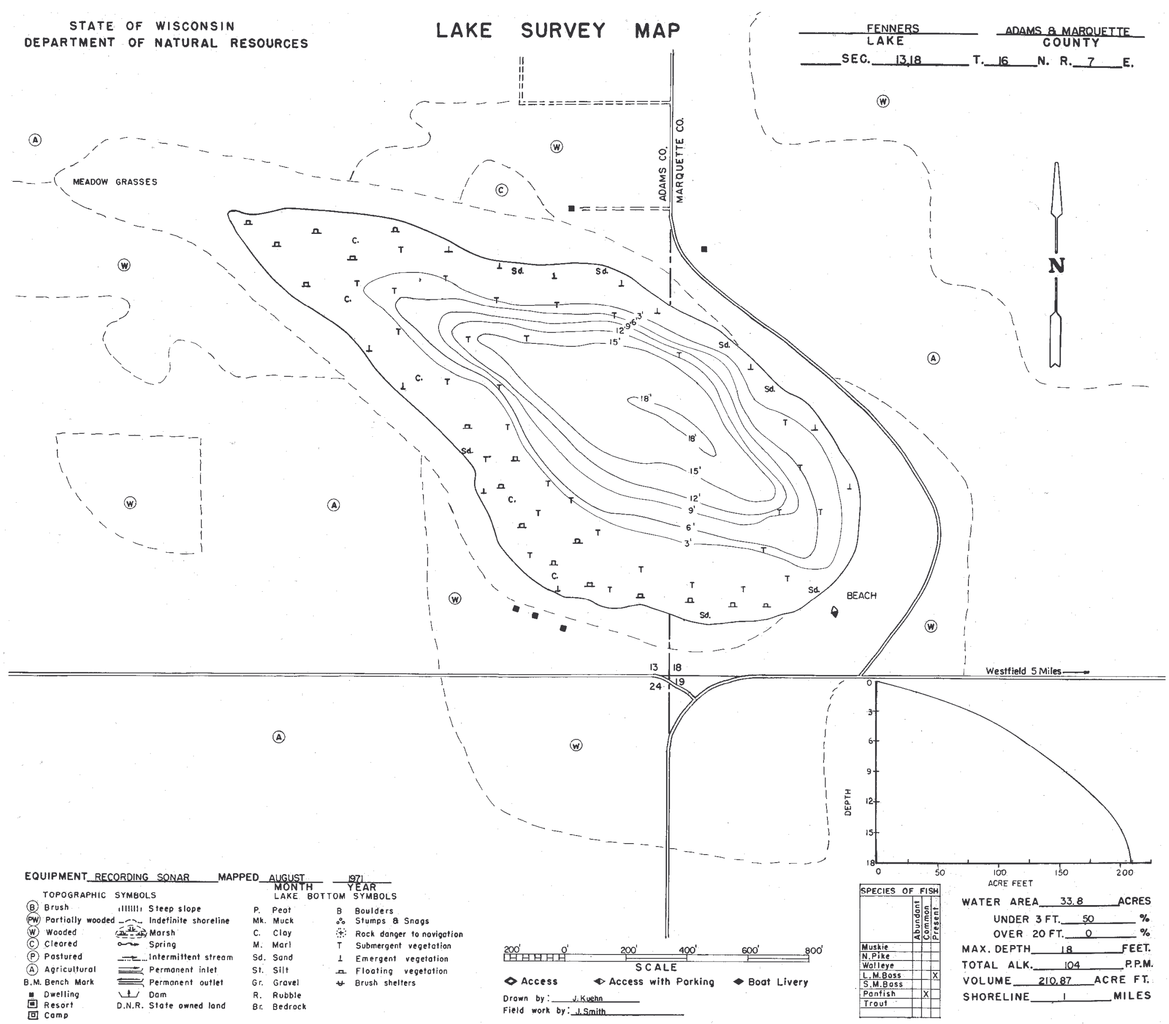
TURBIDITY: Turbidity reflects water clarity. The term refers to suspended solids in the water column—solids that may include clay, silt, sand, plankton, waste, sewage and other pollutants. Turbid water may mask the presence of bacteria or other pollutants because the water looks murky or muddy. In general, turbidity readings of less than 5 NTU are best. Very turbid waters may not only smell, but also tend to be aesthetically displeasing, thus curtailing recreational uses of the water. Turbidity levels for Fenner Lake's waters were 1.38NTU in 2004, 1.9 NTU in 2005, and 1.9 NTU in 2006—all very low levels.

Figure 31 & 32
Examples of Very Turbid Water

HYDROLOGIC BUDGET

Fenner Lake has a surface area of 33.8 acres. According to the 1975 bathymetric (depth) map (the most recent one available), the volume of the lake is 210.9 acre-feet, and the mean depth is 6.2 feet. The maximum depth is 18 feet.

Figure 33: Fenner Lake Bathymetric Map

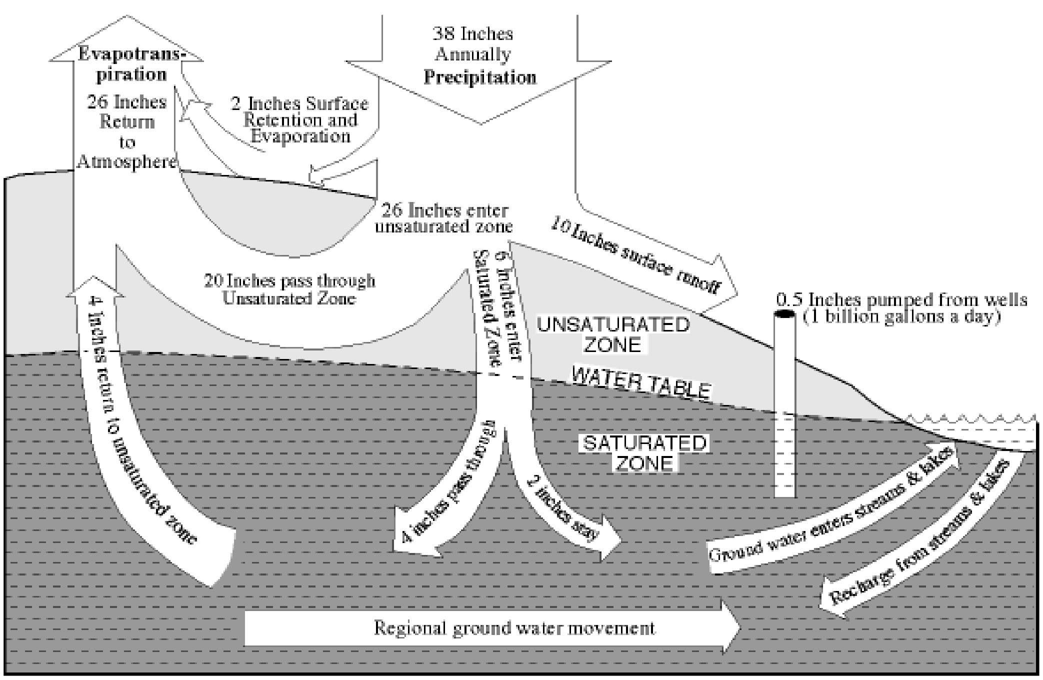


A “hydrologic budget” is an accounting of the inflow to, outflow from and storage in a hydrological unit (such as a lake). “Residence time” is the average length of time particular water stays within a lake before leaving it. This can range from several days to years, depending on the type of lake, amount of rainfall, and other factors. The “flushing rate” is the amount of time it takes for the volume of the lake to be replaced. The “drainage area” is the amount of area (in acres) contributing surface water runoff and nutrients to the lake. The “areal water load” is the total annual flow volume reaching the lake divided by the surface area of the lake. “Hydraulic loading” is the total annual volume of all water sources (including precipitation, non-point sources & point sources) loading into the lake.

Using the data gathered from historical testing and that done by the Adams County LWCD from 2004-2006, the WiLMS model calculated the tributary drainage area for Fenner Lake as 2129.7 acres. The average unit runoff for Adams County in the Fenner Lake area is 9.4 inches. WiLMS determined the expected annual runoff volume as 1668.3 acre-feet/year. Anticipated annual hydraulic loading is 1015.4 acre-feet/year. Areal water load is 30 feet/year.

In a seepage lake like Fenner Lake, water and its nutrient load tend to stay longer within the lake before leaving it than in a lake with an inlet and/or outlet—in Fenner Lake’s case, modeling estimates a water residence of 0.21years. Flushing time is 4.81 1-year.

Figure 34: Example of Hydrologic Budget



TROPHIC STATE

The trophic state of a lake is one measure of water quality, basically defining the lake's biological production status (See Figure 35). **Eutrophic lakes** are very productive, with high nutrient levels, frequent algal blooms and/or abundant aquatic plant growth. **Oligotrophic lakes** are those low in nutrients with limited plant growth and small populations of fish. **Mesotrophic lakes** are those in between, i.e., those which have increased production over oligotrophic lakes, but less than eutrophic lakes; those with more biomass than oligotrophic lakes, but less than eutrophic lakes; often with a more varied fishery than either the eutrophic or oligotrophic lakes. In comparing water quality testing results with the prediction from the computer modeling of this modeling with the actual figures outlined above, the actual Trophic State of Fenner Lake is what was predicted from the modeling. Modeling results predicted that the overall TSI for Fenner Lake would be **45**. This score places Fenner Lake's overall TSI above the average overall TSI for natural lakes in Adams County of 43.88.

Figure 35: Trophic Status Table

Fenner Lake = 45

Score	TSI Level Description
30-40	**Oligotrophic:** clear, deep water; possible oxygen depletion in lower depths; few aquatic plants or algal blooms; low in nutrients; large game fish usual fishery
40-50	**Mesotrophic:** moderately clear water; mixed fishery, esp. panfish; moderate aquatic plant growth and occasional algal blooms; may have low oxygen levels near bottom in summer
50-60	**Mildly Eutrophic:** decreased water clarity; anoxic near bottom; may have heavy algal bloom and plant growth; high in nutrients; shallow eutrophic lakes may have winterkill of fish; rough fish common
60-70	**Eutrophic:** dominated by blue-green algae; algae scums common; prolific aquatic plant growth; high nutrient levels; rough fish common; susceptible to oxygen depletion and winter fishkill
70-80	**Hypereutrophic:** heavy algal blooms through most of summer; dense aquatic plant growth; poor water clarity; high nutrient levels

Phosphorus concentration, chlorophyll-a concentration and water clarity data are collected and combined to determine a trophic state. As discussed earlier, the average summer epilimnetic total phosphorus for Fenner Lake was 32 micrograms/liter. The average summer chlorophyll-a concentration was 3.2 milligrams/liter. Growing season water clarity averaged a depth of 9.66 feet. Figure 36 shows where each of these measurements from Fenner Lake fall in trophic level.

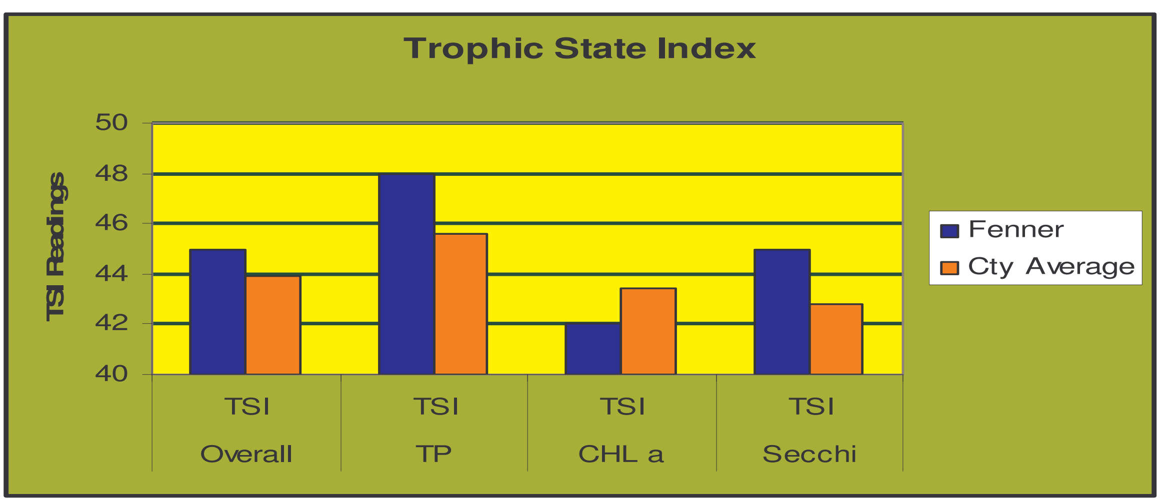
Figure 36: Fenner Lake Trophic Status Overview

Trophic State	Quality Index	Phosphorus (ug/l)	Chlorophyll a (ug/l)	Sechhi Disk (ft)
Oligotrophic	Excellent	<1	<1	>19
	Very Good	1 to 10	**1 to 5**	**8 to 19**
Mesotrophic	Good	**10 to 30**	5 to 10	6 to 8
	Fair	30 to 50	10 to 15	5 to 6
Eutrophic	Poor	50 to 150	15 to 30	3 to 4
Fenner Lake		**21**	**3.2**	**9.66**

These figures show that Fenner Lake has low levels overall for the three parameters often used to describe water quality: Secchi disk depths; average TP for the growing season; and chlorophyll a levels. It is normal for all of these values to fluctuate during a growing season. However, they can be affected by human use of the lake, by summer temperature variations, by algae growth & turbidity, and by rain or wind events. According to these results, Fenner Lake scores as **"mesotrophic"** in its phosphorus level, and "oligotrophic" in chlorophyll-a readings and Secchi disk readings. With such phosphorus readings and chlorophyll a readings, dense plant growth and frequent algal blooms would not be expected.

Fenner Lake ranks slightly higher in all parameters than the average natural lake in Adams County, as shown in Figure 36. In the TSI index, this is not a positive factor.

Figure 37: TSI for Fenner Lake & County Average



IN-LAKE HABITAT

Aquatic Plants

A healthy aquatic plant community plays a vital role within the lake community. This is due to the role plants play in improving water quality, providing valuable habitat resources for fish and wildlife, resisting invasions of non-native species and checking excessive growth of the most tolerant species.

An aquatic plant survey was done on Fenner Lake in the summer of 2005 by staff from the WDNR and the Adams County LWCD. Fenner Lake is a mesotrophic lake with good water quality and clarity. Water clarity has decreased since 1993. Filamentous algae are common in Fenner Lake, abundant in the 10-20ft depth zone. The aquatic plant community colonized approximately three-quarters of Fenner Lake and covered 100% of the littoral zone to a maximum rooting depth of 15 feet. The 0-1.5ft depth zone supported the most abundant aquatic plant.

The Fenner Lake aquatic plant community is characterized by high quality and excellent species diversity. The plant community is in the top quartile of lakes in the state and region, the group of lakes closest to an undisturbed condition and with an average sensitivity to disturbance.

Myriophyllum sibiricum (Northern watermilfoil) was the most frequently occurring species in Fenner Lake in 2005. *Ceratophyllum demersum* (coontail), *Chara* spp. (muskgrass), *Elodea canadensis* (common waterweed), *Najas flexilis* (bushy pondweed), *Nymphaea odorat* (white water lily), *Potamogeton gramineus* (variable-leafed pondweed), *Potamogeton natans* (floating-leaf pondweed) and *Potamogeton zosteriformis* (flat-stemmed pondweed) were also commonly occurring species.

Myriophylum sibiricum was also the species with the highest mean density in Fenner Lake and exhibited an above average growth density where it was present. Seven other species also had above average growth density where they were found. *Myriophyllum sibiricum* was also the dominant aquatic plant species in Fenner Lake. *Ceratophyllum demersum* and *Nymphaea odorata* were sub-dominant.

Myriophyllum sibiricum was the most frequently occurring species in the 0-1.5 ft depth zone and the dominant species in the 5-10ft depth zone. It occurred at its highest frequency and density in the 5-10ft depth. *Nymphaea odorata*, one of the sub-dominant species overall, was the dominant species in the 1.5-5ft depth zone and the species with the highest mean density in the 0-1.5ft depth zone. It occurred at its highest frequency and density in the 1.5-5ft depth zone. *Ceratophyllum demersum,* the other sub-dominant, was dominant in the 10-20ft zone.

Figure 38: Fenner Lake Aquatic Plant Species 2005

Scientific Name	Common Name
Emergent Species	
1) *Calamagrostis canadensis* (Michx.) P.Beauv.	bluejoint grass
2) *Carex comosa* Boott.	bristly sedge
3) *Eleocharis smallii* Britt.	creeping spikerush
4) *Glyceria canadensis* (Michx) Trin.	rattlesnake manna grass
5) *Juncus brevicaudatus* (Englem) Fern.	rush
6) *Rumex orbiculatus* Gray.	great water dock
7) *Scirpus validus* Vahl.	softstem bulrush
Floating-leaf Species	
8) *Nuphar variegata* Durand.	bull-head pond lily
9) *Nymphaea odorata* Aiton.	white water lily
10) *Polygonum amphibium* L.	water smartweed
Submergent Species	
11) *Ceratophyllum demersum* L.	coontail
12) *Chara* sp.	muskgrass
13) *Eleocharis acicularis* (L.) R & S.	needle spikerush
14) *Elodea canadensis* Michx.	common waterweed
15) *Myriophyllum heterophyllum* Michx.	variable-leaf water-milfoil
16) *Myriophyllum sibiricum* Komarov.	common water milfoil
17) *Myriophyllum spicatum* L.	Eurasian water milfoil
18) *Najas flexilis* (Willd.) Rostkov & Schmidt.	slender naiad
19) *Najas guadalupensis* (Spreng.) magnus .	common water-nymph
20) *Potamogeton amplifolius* Tuckerman.	large-leaf pondweed
21) *Potamogeton foliosus* Raf.	leafy pondweed
22) *Potamogeton gramineus* L.	variable-leaf pondweed
23) *Potamogeton illinoensis* Morong.	Illinois pondweed
24) *Potamogeton natans* L.	floating-leaf pondweed
25) *Potamogeton pectinatus* L.	sago pondweed
26) *Potamogeton pusillus* L.	small pondweed
27) *Potamogeton zosteriformis* Fern.	flatstem pondweed
28) *Utricularia gibba* L.	small bladderwort
29) *Utricularia vulgaris* L.	great bladderwort

Of the 29 aquatic species found in the survey in 2005, seven were emergents, three were rooted floating-leaf plants, and nineteen were submergent plants, including a few sensitive species. *Myriophyllum spicatum* (Eurasian watermilfoil), an aggressive invasive species, was also found to the left of the boat ramp in 2005. The area where it was found was exposed by low water levels in 2007. However, visual survey of Fenner Lake in October of 2007 revealed that the invasive had spread substantially from that first growth area, to the point that the Fenner Lake Association will need to take action to contain it.

The study used the results of the 2005 field survey to evaluate Fenner Lake by using several standard community measurements. For example, the Simpson's Diversity Index was 0.94, indicating very good species diversity. A rating of 1.0 would mean that each plant in the lake was a different species (the most diversity achievable).

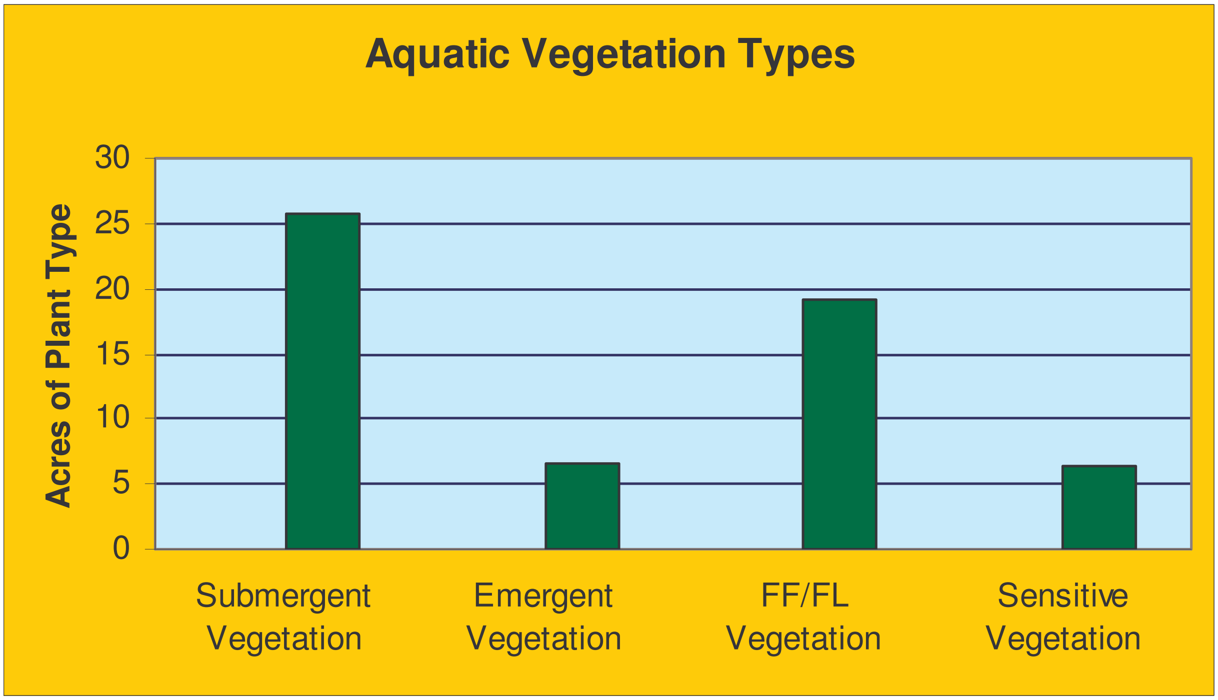
The Aquatic Macrophyte Community Index (AMCI) for Fenner Lake is 60. This is in the upper quartile of lakes in Wisconsin and the North Central Hardwoods Region of the state. This value places Fenner Lake in the top 25% of lakes in the state and region with the highest quality aquatic plant communities.

The Average Coefficient of Conservatism of 5.93 for Fenner Lake was average for Wisconsin lakes and in the highest quartile for lakes in the North Central Hardwood Region. This suggests that the aquatic plant community in Fenner Lake has an average sensitivity to disturbance for Wisconsin lakes and a high sensitivity for lakes in the region.

The Floristic Quality Index of the aquatic plant community was 31.37 in Fenner Lake, in the upper quartile of Wisconsin lakes and North Central Hardwood Region lakes. This indicates that the plant community in Fenner Lake is within the group of lakes in the state and region closest to an undisturbed condition.

Based on water clarity, chlorophyll and phosphorus data, Fenner Lake is a mesotrophic lake with good water clarity and quality. However, trend analysis suggests water quality has declined during 1993-2005. The current trophic state would support moderate plant growth and occasional algae blooms. Filamentous algae occurred at 36% of the sites and were common in the 0-5ft depth zone and abundant in the 10-20ft depth zone. Adequate nutrients (trophic state), the good water clarity, the moderately hard water and the gradually sloped littoral zone in Fenner Lake would favor plant growth. The abundance of high-density sand sediments in the shallowest zone and dominance of flocculent sediments overall in Fenner Lake could limit plant growth.

Figure 39: Aquatic Plant Types in Fenner Lake 2005



A comparison of the aquatic plant community in Fenner Lake from disturbed shorelines and undisturbed shorelines was also part of the 2005 Aquatic Plant Survey evaluation. Two types of disturbed cover, cultivated lawn and hard structures, were commonly occurring and cultivated lawn covered 11% of the shoreline. Shorelines with cultivated lawn can impact the plant community through increased run-off of lawn fertilizers, pesticides and pet wastes into the lake. Hard structures and mowed lawn also speed run-off to the lake without filtering these pollutants. Expanding and protecting the buffer of natural vegetation along the shore will help prevent shoreline erosion and reduce additional nutrient/chemical run-off that can add to algae growth and sedimentation of the lake bottom.

The dominant species was the same at disturbed and natural shoreline communities, but the sub-dominant species was different. At natural shoreline sites, *Nymphaea odorata,* a species that is a premier habitat species was sub-dominant. At disturbed shoreline, *Ceratophyllum demersum,* a species more tolerant of disturbance, known to grow to nuisance levels with nutrient enrichment (and can) to become too dense to provide quality habitat, was sub-dominant.

The quality of the aquatic plant community at the natural shoreline sites (AMCI – 65) is greater than the quality of the plant community at the disturbed sites (AMCI – 60). The higher quality is due to a higher frequency of occurrence of sensitive aquatic plant species (Nichols 2000) at natural shoreline communities and lack of exotic species at natural shoreline sites. The most sensitive species in Fenner Lake occurred at a much higher frequency, grew at a higher density and had a higher dominance at the sites near natural shoreline This corroborates the impact disturbed shoreline has on the aquatic plant community. Eurasian watermilfoil was only recorded at disturbed shoreline sites. Disturbance creates an ideal condition for the invasion of exotic species such as Eurasian watermilfoil.

The cover of submergent vegetation, emergent vegetation and floating-leaf vegetation was higher at natural shoreline plant communities. The higher occurrence of emergent and floating-leaf species at natural sites is particularly important from the habitat view. These species are especially valuable for habitat and, with the submergent vegetation, they add a diversity of structural types which supports greater diversity in the fish and wildlife community.

Filamentous algae occurred at a higher percentage of sites at disturbed shoreline as compared to natural shoreline. This suggests nutrient enrichment at disturbed shoreline sites. Nutrient sources could be lawn fertilizers, failing or poorly maintained septic systems, pet wastes and poorer filtering capacity of hard surfaces and mowed lawns.

Figure 40a: Emergent Aquatic Plants in Fenner Lake (2005)

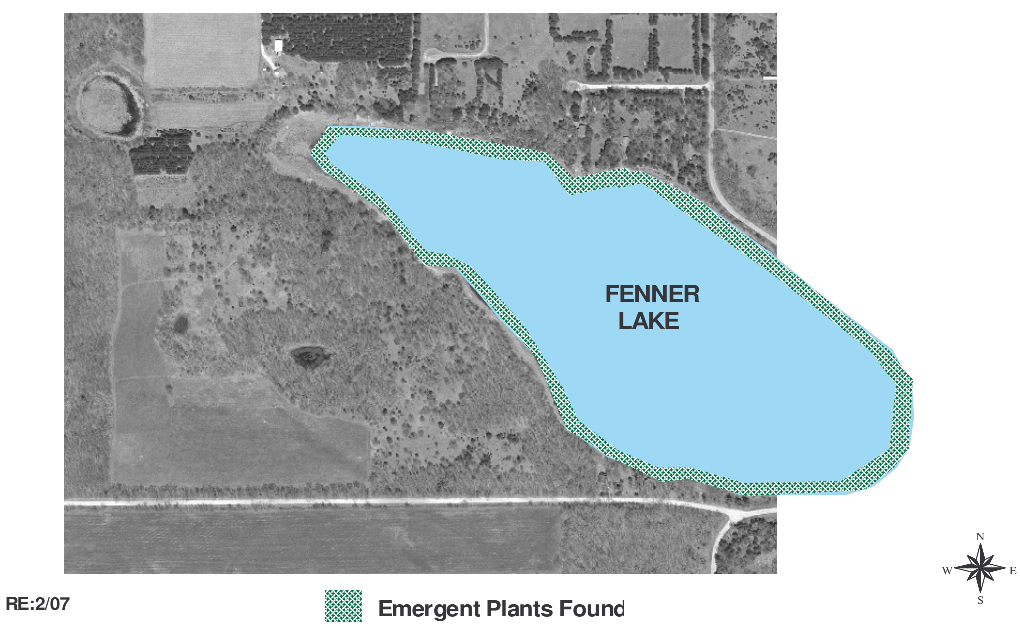
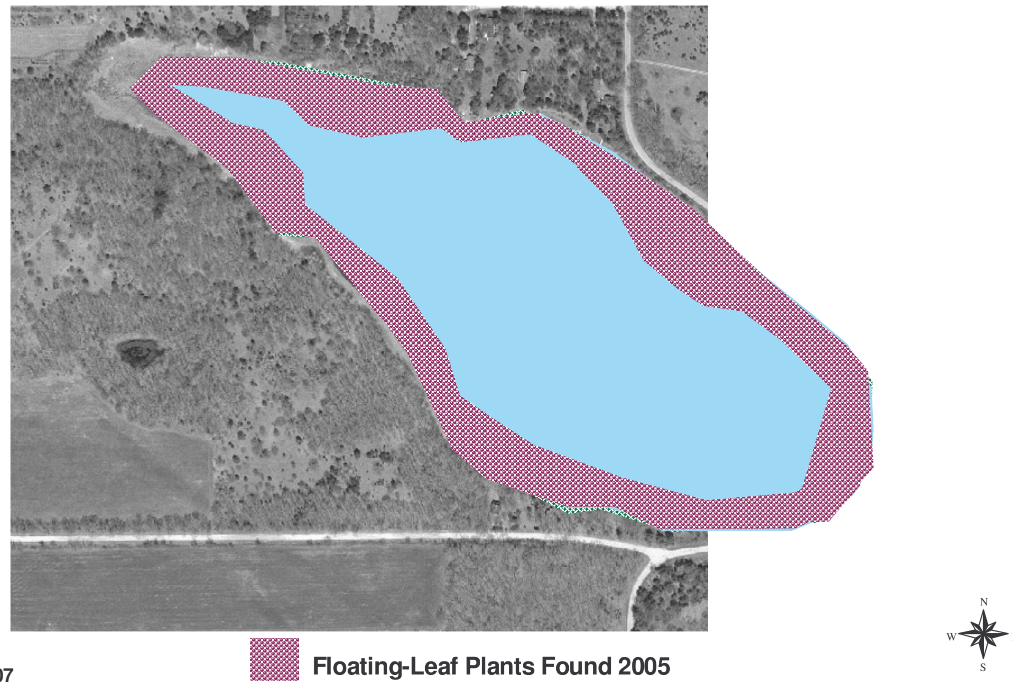
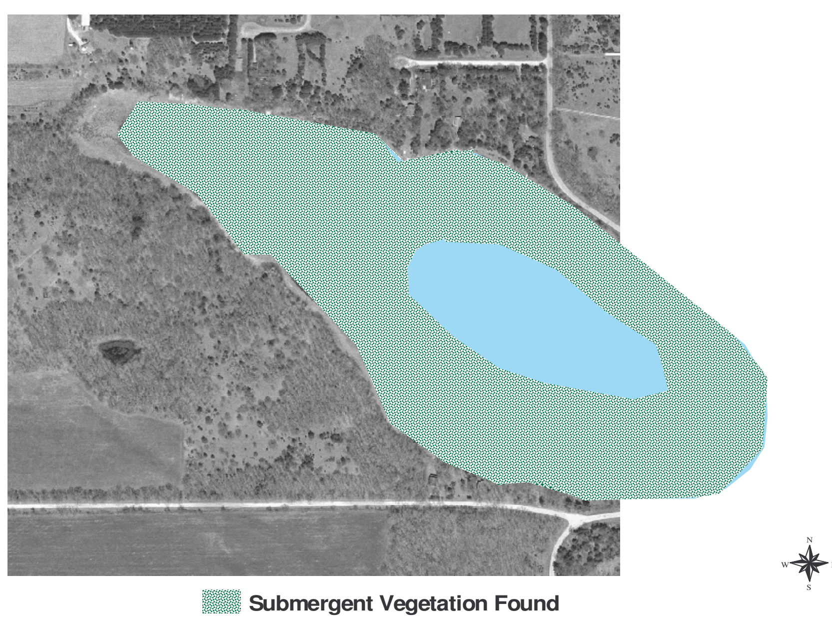


Figure 40b: Floating Leaf Plants in Fenner Lake (2005)



RE:2/07

Figure 40c: Submergent Aquatic Plants in Fenner Lake (2005)



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Nymphaea odorata
(White Water Lily)

Chara **spp (Muskgrass)**

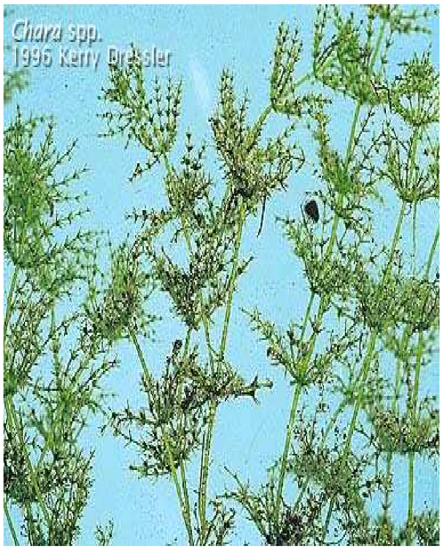


Figure 41: Most Common Native Aquatic Species in Fenner Lake

Myriophyllum sibiricum
(Northern Milfoil)

Ceratophyllum demersum
Coontail

Aquatic Invasives

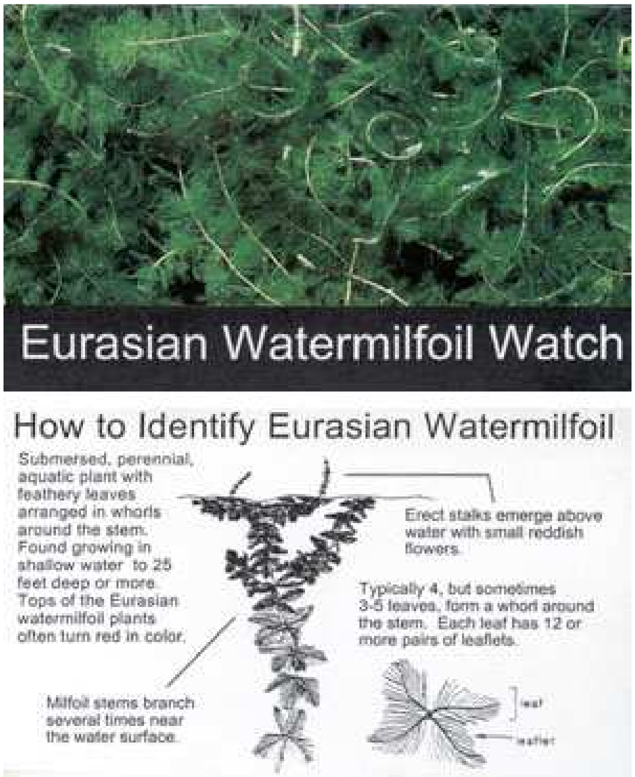
Eurasian Watermilfoil was introduced in Fenner Lake shortly before it was found in July 2005, when it was found directly to the left of the boat ramp and directly across from it. However, by summer 2007, it had moved along the lakeshore in both directions from the boat ramp. The Fenner Lake Association will have to develop a plan for monitoring and managing the Eurasian Watermilfoil population and take necessary treatment steps to keep it managed. Figure 42 shows where the plant was originally found in 2005 (purple). Figure 43 indicates where it was found in 2007 (yellow).

Figure 42: Distribution of Exotic Aquatic Plants in 2005

Figure 43: Eurasian Watermilfoil Found 2007

So far, *Potamogeton crispus* (Curly-Leaf Pondweed) was seen in scattered spots during the critical habitat field survey in May 2006. This might have been missed in the 2005 survey because that survey occurred in late July, after Curly-Leaf Pondweed has usually dried off.   With two invasive species identified already, ongoing monitoring for invasives should occur, now that the lake has been "invaded."

Figure 44: Invasives Known to Occur in Fenner Lake



found 2005 was
Myriophyllum spicatum
(Eurasian Watermilfoil);

found 2006 was
Potamogeton cripus
(Curly-Leaf Pondweed)

Critical Habitat

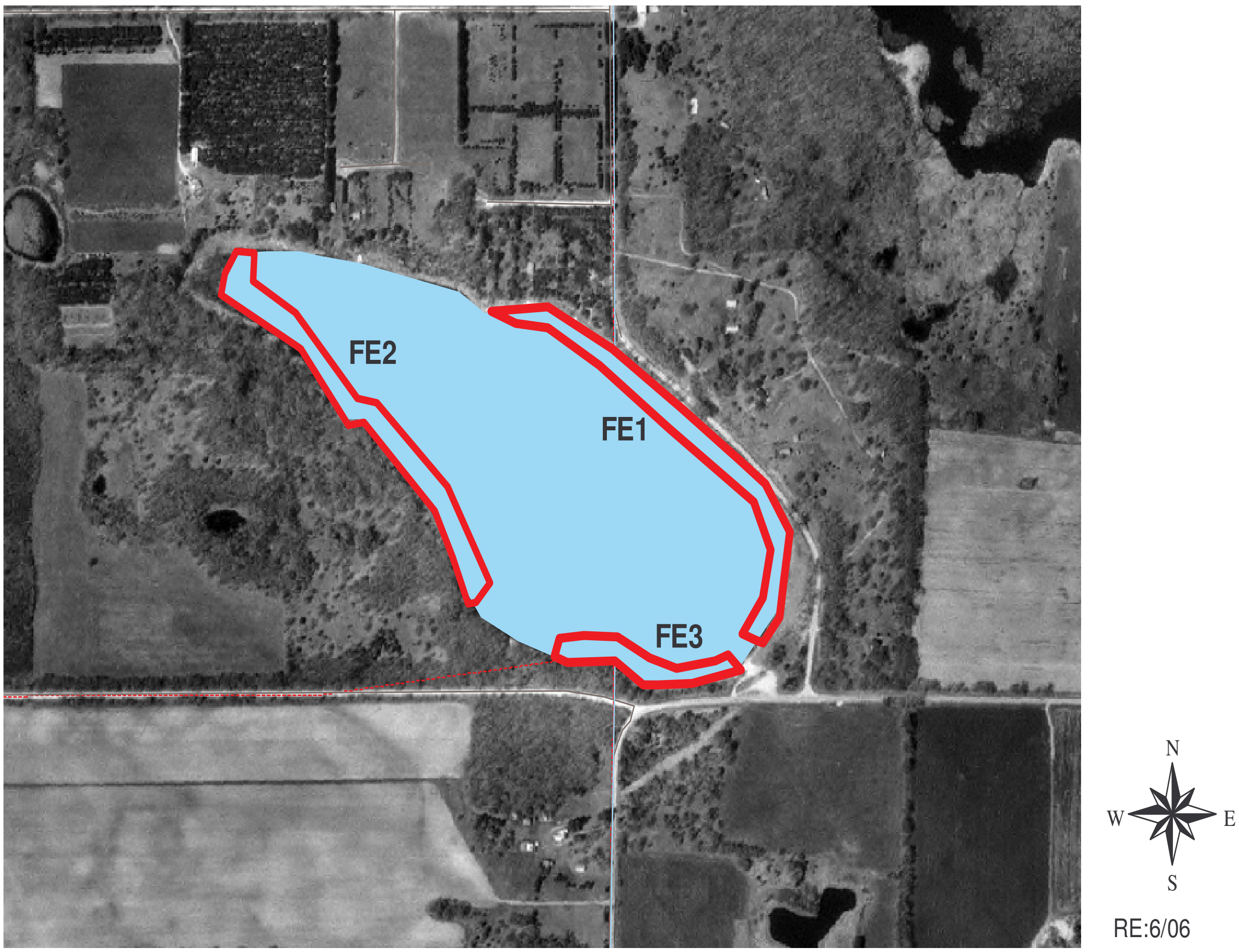
Designation of critical habitat areas within lakes provides a holistic approach for assessing the ecosystem and for protecting those areas in and near a lake that are important for preserving the qualities of the lake. Wisconsin Rule 107.05(3)(i)(I) defines a "critical habitat areas" as: "areas of aquatic vegetation identified by the department as offering critical or unique fish & wildlife habitat or offering water quality or erosion control benefits to the body of water. Thus, these sites are essential to support the wildlife and fish communities. They also provide mechanisms for protecting water quality within the lake, often containing high-quality plant beds. Finally, critical habitat areas often can provide the peace, serenity and beauty that draw many people to lakes.

Protection of critical habitat areas must include protecting the shore area plant community, often by buffers of native vegetation that absorb or filter nutrient & stormwater runoff, prevent shore erosion, maintain water temperature and provide important native habitat. Buffers can serve not only as habitats themselves, but may also provide corridors for species moving along the shore.

Besides protecting the landward shore areas, preserving the littoral (shallow) zone and its plant communities not only provides essential habitat for fish, wildlife, and the invertebrates that feed on them, but also provides further erosion protection and water quality protection.

Field work for a critical habitat area study was performed on May 25, 2006, on Fenner Lake, Adams County. The study team included: Scot Ironside, DNR Fish Biologist; Deborah Konkel, DNR Aquatic Plant Specialist; Patrick (Buzz) Sorge, DNR Lakes Manager, and Reesa Evans, Adams County Land & Water Conservation Department. Areas were identified visually, with GPS readings and digital photos providing additional information. Input was also received from Terry Kafka, DNR Water Regulation, and Jim Keir, DNR Wildlife Biologist.

Figure 45: Critical Habitat on Fenner Lake



Critical Habitat Area FE1

This area extends along approximately 1500 feet of the northeast shoreline, up to the ordinary high water mark and, where there are wetlands, landward of the lake through the wetlands. 12.5% of the shore is wooded; 17.5% has shrubs; 47.5% is native herbaceous cover. The balance of the shore in this area includes a small area of cultivated lawn and pavement. Large woody cover is present for habitat. With human disturbance along this shoreline, the area has some natural scenic beauty, although a paved road runs near the area.

Figure 46: Part of FE1

Filamentous algae were abundant at this site.

This area of large woody cover, emergent aquatic vegetation, submergent and floating vegetation provides spawning and nursery areas for many types of fish: northern pike; largemouth bass; bluegill; pumpkinseed; yellow perch; crappie; bullhead; suckers, and other panfish. All of these fish also feed and take cover in these areas. No exotic aquatic wildlife was noted in this area, i.e, no carp, smelt or rusty crayfish were seen.

Songbirds were heard during the field survey. Frogs and salamanders are known to use this area for shelter/cover, nesting and feeding. Turtles and snakes also use this area for cover or shelter in this area, as well as nested and fed in this area.

Several types of aquatic plants were found in this critical habitat area: emergents (seven species); floating-leaf rooted plants (three species); and submergent plants (thirteen species). One exotic invasive plant, *Potamogeton crispus,* was seen in this area, Curly-Leaf Pondweed in 2006.

Critical Habitat Area FE2

This area extends along approximately 2500 feet along the southwest shoreline. . 22.5% of the shore is wooded; 7.5% has shrubs; and 61.25% is native herbaceous cover. The remaining shore in this area is cultivated lawn and hard structure. Large woody cover is present. With minimal human disturbance along this shore, the area is has natural scenic beauty.

This area of large woody cover, emergent aquatic vegetation, submergent and floating vegetation provides spawning and nursery areas for many types of fish: northern pike; largemouth bass; bluegill; pumpkinseed; yellow perch; crappie; bullhead; suckers, and other panfish. All of these fish also feed and take cover in these areas. No exotic aquatic wildlife was noted in this area, i.e, no carp, smelt or rusty crayfish were seen. No development was present in FE2 near the shore; houses were set back up a steep slope.

Seen during the field survey were various types of waterfowl and songbirds. Frogs and salamanders are known to use this area for shelter/cover, nesting and feeding. Turtles and snakes also use this area for cover or shelter in this area, as well as nested and fed in this area. Upland wildlife feed and nest here as well. Since human disturbance is relatively light in FE2, it provides high-quality habitat for many types of wildlife.

Maximum rooting depth in FE2 was 15 feet. No threatened or endangered species were found in this area. Filamentous algae were not common in this area. Found at this site were six emergent aquatic plant species, three floating-leaf rooted plant species, and thirteen submergent aquatic species.

Figure 47: Photo of Part of FE2

CRITICAL HABITAT AREA FE3

This area extends along approximately 450 feet of the southeast shoreline. 32.5% of the shore is wooded; 12.5% has shrubs; 32.5% is native herbaceous cover—the remaining is bare sand. Large woody cover is common. Scenic beauty in part of the area is lessened due to the human development, especially the proximity of the sand boat ramp area.

This area does provide spawning and nursery areas for many types of fish: northern pike; largemouth bass; bluegill; pumpkinseed; yellow perch; crappie; bullhead; suckers, and other panfish. All of these fish also feed and take cover in these areas. No exotic aquatic wildlife was noted in this area, i.e, no carp, smelt or rusty crayfish were seen.

Seen during the field survey were various types of waterfowl and songbirds. Frogs are known to use this area for shelter/cover, nesting and feeding. Turtles were seen in this area for cover or shelter in this area.

Maximum rooting depth in CR3 was 14.5 feet. No threatened or endangered species were found in this area. One exotic invasive, *Myriophyllum spicatum* (Eurasian watermilfoil), was found in this area in 2005. Filamentous algae were present here, especially near the shores. This area had fewer varieties of emergent plants than did the other two critical habitat areas on Fenner Lake: only three emergent aquatic plant species were found in this area. There were also two floating-leaf rooted species and nine submergent aquatic plant species.

Figure 48: Photo showing part of FE3

Recommendations for Critical Habitat Areas

(1) Maintain current habitat for fish and wildlife.
(2) Do not remove fallen trees along the shoreline.
(3) No alteration of littoral zone unless to improve spawning habitat.
(4) Seasonal protection of spawning habitat.
(5) Maintain snag/cavity trees for nesting.
(6) Install nest boxes.
(7) Maintain or increase wildlife corridor.
(8) Protect emergent vegetation.
(9) Minimize aquatic plant and shore plant removal to maximum 30' wide viewing/access corridor. Leave as much vegetation as possible to protect water quality and habitat.
(10) Seasonal control of Curly-Leaf Pondweed and Eurasian Watermilfoil, using control methods selective for exotics.
(11) Use best management practices.
(12) No use of lawn products.
(13) No bank grading or grading of adjacent land.
(14) No pier placement, boat landings, development or other shoreline disturbance in the shore area of the wetland corridor.
(15) No pier construction or other activity except by permit using a case-by-case evaluation.
(16) No installation of pea gravel or sand blankets.
(17) No bank restoration unless the erosion index scores moderate or high.
(18) If the erosion index does score moderate or high, bank restoration only using biologs or similar bioengineering, with no use of riprap or retaining walls.
(19) Placement of swimming rafts or other recreational floating devices only by permit.
(20) Maintain buffer of shoreline vegetation.
(21) Maintain aquatic vegetation in undisturbed condition for wildlife habitat, fish use and water quality protection.
(22) Post exotic species warning at boat landing.
(23) Maintain no-motor lake designation.

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FISHERY/WILDLIFE/ENDANGERED RESOURCES

WDNR fish stocking records for Fenner Lake go back to 1957 with the stocking of some northern pike. Through the fifteen years after that, pike continued to be stocked, as well as bluegills and largemouth bass. An aerator was installed in 1976 to prevent winter kill of fish. Fish known in Fenner Lake include northern pike, largemouth bass, bluegill, pumpkinseed, yellow perch, crappie, bullhead, suckers and other panfish. No rusty crayfish were noted.

Seen during the critical habitat field survey were various types of waterfowl, songbirds, and turkey. Frogs and salamanders are known, using the lake shores for shelter/cover, nesting and feeding. Turtles and snakes also use this area for cover or shelter in this area, as well as nested and fed in this area. Upland wildlife feed and nest here as well.

Fenner Lake Watersheds shelter several natural communities designated by the WDNR as communities that are endangered: Calcareous fen; Emergent marsh; Northern sedge meadow; Oak barrens; Open bog; and Southern sedge meadow.

Figure 49: Photo of Oak Barrens, An Endangered Natural Community

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